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ABSTRACT

This document, which is intended to assist developers of instructional programs in preparing Oregon students for employment in the manufacturing industry, discusses past and projected labor supply/demand in Oregon's manufacturing industry and identifies employment qualifications and job duties/tasks for manufacturing technology occupations. Fifty-six employability skills in areas such as identifying employment opportunities, seeking employment, demonstrating appropriate work behavior, maintaining a safe and healthy work environment, working with others, and adapting to change are listed. Presented next is a manufacturing technology duty/task inventory matrix listing 306 tasks in 29 categories, including the following: operating various manufacturing machinery and equipment; performing layouts; taking precision measurements; performing heat treatment operations; assembling and disassembling mechanisms; installing and removing machinery; maintaining electronic control systems, and hydraulic and pneumatic systems; installing and maintaining automated systems; programming and planning; performing quality control/quality assurance, communication, housekeeping/recordkeeping, and supervisory functions; and demonstrating industrial standards. Next, guide sheets are provided for each of the 306 duties/tasks. Each guide sheet includes the following: performance objective; list of tools/equipment used; and performance guide (list of the steps involved in performing the duty/task). (MN)

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ED 384 751

REPORT

OF THE

TECHNICAL COMMITTEE FOR MANUFACTURING OCCUPATIONS

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INTRODUCTION

The Carl D. Perkins Vocational Education Act (PL 98-524) requires that each state establish at least two technical committees per year. The purpose of these technical committees is to identify the skills and knowledges required for occupations for which training is provided in the state.

The technical committees are composed of members from business, industry, professional associations, and labor, as well as persons with special expertise. In addition, there is one ex officio representative from each of the following areas:

- State Advisory Council for Career and Vocational Education
- Secondary vocational programs
- Community college vocational programs
- Teacher education/higher education

The committees identify the skills and knowledges required in the occupation at three levels.

1. Entry--The skills necessary to obtain the job.
2. Retention--The skills necessary to retain the job beyond the probationary period.
3. Adanced--The skills necessary to advance in the occupation; i.e., journeyperson level.

This report reflects many hours and a strong commitment to educational excellence on the part of the committee members. The Department appreciates the work of the committee.

This work was used to determine the competencies required in each vocational program and to improve the existing curriculum statewide.

Business and industry members joined with additional educators to form the education committee which developed additional materials for use in curriculum development.

For more information contact Clyde Rasmussen, Specialist, Manufacturing Technology Occupations.

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STATEMENT OF THE MANUFACTURING TECHNICAL COMMITTEE

It is the intent of the committee that this document will be used to develop and implement change in the instructional programs of Oregon schools.

In the document, the committee has identified the employability skills, technical skills, and performance objectives necessary for machine tool operator, maintenance machinist, precision machinist, tool and die maker, model maker, mold maker, production worker, supervisor, apprentice and automated manufacturing machinist. This work is directly related to current manufacturing industry standards in the occupations relating to machining.

The committee recommends adding members from all the recognized technical occupation areas: plastics, sheet metal, welding fab, foundry, machining, design/drafting--CAD.

The next phase of the committee's work should concentrate on the areas of Precision Sheet Metal/Fabrication in close conjunction with the project taking place with Clackamas Community College and the Precision Sheet Metal Association. A minority report from the committee is that one of the next areas of investigation should encompass CAD/CAM or CAM Technician skills as a new and emerging job title. The advances of technology are making new duties, tasks, and job titles viable.

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MANUFACTURING TECHNOLOGY
DEMAND/SUPPLY INFORMATION

Program Area	1988 Employment	1988 Openings	1987 Unemployed	1987 Unempl. Rate	1993 Proj. Empl.
Industrial Technology	1,137	46	112	8.9%	1,190
Metallurgical Technology	255	8	9	3.4%	278
Automotive Body Repair	2,456	97	459	15.7%	2,639
Foundry	1,357	55	45	3.2%	1,503
Machine Shop/Tool Operation	10,702	366	1,103	9.3%	11,371
Sheet Metal	2,284	81	254	10.0%	2,412
Welding, Brazing & Soldering	4,996	153	1,390	21.7%	5,302
Precision Metalwork, Other	2,664	99	608	18.5%	2,834
Jewelry Design & Repair	304	22	37	10.8%	326
Plastics	663	25	30	4.3%	734
TOTAL	26,818	952	4,047	13.1%	28,589

An overall surplus of workers remains in the Manufacturing Technology cluster. The ratio of unemployed to openings is clearly in the surplus range. The unemployment rate for the cluster is double that to be attributed to frictional unemployment. The ratio of educational supply (including high school supply) to openings is approximately one to one.

Oregon Occupational Information
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March 31, 1988

OUTLOOK FOR MANUFACTURING TECHNOLOGY
1988-1993

The diversity of occupations included in the area of Manufacturing Technology makes generalizations about outlook difficult. Many have been severely impacted by the introduction of new technology and by the recession of the early 1980s. To give a perspective on the outlook for Manufacturing Technology, key occupations will be analyzed.

Welders and Cutters. Welders are expected to grow very slowly if at all, into the 1990s. The large number of experienced unemployed welders will limit opportunities for new entrants. Technological change will continue to affect the demand for welders. Advances in robotics, visual and other machine-sensing capabilities and computer-aided manufacturing have transformed production processes leading to a sharp decline in the number of production welding jobs. The use of high-strength composite materials and improved plastics in place of metal in a wide range of products - from automobiles to trucks to home appliances - will also decrease the demand for production welders. Welding has increasingly become a skill used in a variety of occupations, not an occupation unto itself.

Firms that produce and repair machinery for the wood products industry are the major employers of welders outside the Portland area. Opportunities for finding a job will remain best in Portland, where there is more construction work and where most large manufacturers of metal products, transportation equipment, and machinery are located.

Machine Tool Operators. The demand for machinists is expected to grow slowly over the next few years. Employment growth will be limited by the growing substitution of nonmetal parts in many products, increasing foreign competition and improvements in metalworking technology. Chief among these improvements is the use of computer-controlled machine tools that significantly reduce the time for machining operations. Prospects will be best for skilled operators who can plan and set up machining operations from blueprints or layouts and for Numerical Control Machine Tool Operators.

Automotive Body Repairers. Employment of auto body repairers is expected to increase at an average rate into the early 1990s. In Oregon, the unemployment rate for this occupation is double that for all occupations, however, and the experienced unemployed may limit employment opportunities for new entrants. The demand for body repairers will increase with the number of cars on the road and also with the advent of lighter weight automobile designs.

Source: Oregon Center Information System, 1987.
Occupational Outlook Handbook, 1986-87 edition.

BACKGROUND AND SUMMARY OF ACTIVITIES

A. Background

Representatives from the machining occupations were invited to participate on the Manufacturing Technical Committee. The purpose of the committee was to validate task inventory listings performed by entry level, retention level, and advanced level classifications.

An initial mailing was sent to each committee member and included a list of major duties and related tasks to the machining occupation:

Machinist Model Maker
- Tool and Die
- Mold Maker

Machinist/General
- Automated Manufacturing Systems
- Maintenance
- Precision Machining

Machinist/Specialist
- Machine tool operator
- Automated machine operator

Production Worker
- Sub-Assembly Helper
- Production Helper

Each task was assigned an entry level, retention level, and/or advanced level on an occupational matrix. The original listings were taken from VTECS catalogs and the Occupational Data Analysis Systems (ODAS) as a basis to begin the refinement to occupational titles for Oregon and labor market information.

B. Summary of Activities

March 1988 was the first meeting of the committee, and they completed the following tasks:

- Mail survey reviewed.
- Industry and performance standards identified.

January 1989 the committee met and completed the following tasks:

- Reviewed and revised the validated task inventory to major duty and performance guide.
- Verified equipment and tool list.

January 1990 the committee met for a final review of the task analysis and equipment and tool list, composed a statement from the committee, and verified the employability skills. Future activities were recommended by the committee.

EMPLOYABILITY SKILLS

Duty A: Identifying Employment Opportunities

Skills:

1. Identify requirements for job.
2. Investigate educational opportunities.
3. Investigate occupational opportunities.
4. Locate resources for finding employment and maintain file.
5. Confer with prospective employers.
6. Identify job trends.

Duty B: Applying Employment Seeking Skills

Skills:

1. Locate job openings.
2. Document skills and abilities (resume).
3. Prepare for interview.
4. Participate in interview.
5. Complete required tests.
6. Complete required forms.
7. Write application letter.
8. Write follow-up letter.
9. Write acceptance letter.
10. Evaluate job offer.
11. Evaluate job rejection.

Duty C: Interpreting Employment Capabilities

Skills:

1. Match interest to job area.

2. Match aptitude to job area.
3. Verify abilities.
4. Identify immediate and future work goals.
5. Conduct personality inventory test.

Duty D: Demonstrating Appropriate Work Behavior

Skills:

1. Exhibit dependability.
2. Demonstrate punctuality.
3. Follow rules and regulations.
4. Recognize the consequences of dishonesty.
5. Complete assignments in accurate and timely manner.
6. Control emotions.
7. Assume responsibility for own decisions and actions.
8. Exhibit pride, loyalty, and self motivation.
9. Exhibit ability to handle pressures and tensions.
10. Demonstrate ability to set priorities.
11. Demonstrate problem-solving skills.
12. Demonstrate proper tool and machine care.
13. Exhibit safety consciousness to make safety a habit.
14. Maintain an attitude of wellness.

Duty E: Maintaining Safe and Healthy Environment

Skills:

1. Comply with safety and health rules.
2. Select correct tools and equipment.
3. Utilize equipment correctly.
4. Use appropriate action during emergencies.
5. Maintain clean and orderly work area.

6. Demonstrate personal hygiene and grooming skills.
7. Apply basic emergency first aid techniques.
8. Complete accident report.
9. Inspect work area and equipment for safe working environment.
10. Report shop, environmental, and equipment safety violations.
11. Demonstrate use of fire extinguisher.
12. Participate in disaster control exercises.
13. Participate in shop safety committee.
14. Correct safety hazards.
15. Comply with safety requirements for working around automated systems.
16. Participate in safety training program.

Duty F: Maintaining Business Image

Skills:

1. Participate in company or agency orientation.
2. Demonstrate knowledge of company or agency products and services.
3. Exhibit positive behavior.
4. Read current job-related publications.
5. Support and promote employer's company image and purpose.
6. Maintain appearance to comply with company standards.
7. Maintain an active membership in related associations.

Duty G: Maintaining Working Relations With Others

Skills:

1. Work productively with others (in teams).
2. Show empathy, respect, compassion, and support for others.
3. Demonstrate procedures and assist others when necessary.
4. Recognize, analyze, and solve or refer problems.

5. Minimize occurrence of problems.
6. Channel emotional reaction constructively.

Duty H: Communicating on the Job

Skills:

1. Read and comprehend written communications and information.
2. Use correct grammar.
3. Speak effectively with others.
4. Use job-related terminology.
5. Listen attentively.
6. Write legibly, and spell correctly.
7. Use telephone etiquette.
8. Follow written and oral directions.
9. Ask questions in planning approach or activities.
10. Locate information in order to accomplish task.
11. Prepare written communication.
12. Utilize keyboarding skills.
13. Utilize computer skills.

Duty I: Adapting to Change

Skills:

1. Recognize need to change.
2. Demonstrate willingness to learn.
3. Demonstrate flexibility.
4. Participate in continuing education.
5. Seek work challenges.
6. Adjust career goals/plan as needed.
7. Seek assistance.

Duty J: Understanding How a Business Works

Skills:

1. Recognize the role of business in the enterprise system.
2. Identify general responsibilities of employees.
3. Identify general responsibilities of management/employers.
4. Participate in meetings.

Duty K: Performing Mathematical Skills

Skills:

1. Add and subtract whole numbers, decimals, and fractions.
2. Multiply and divide whole numbers, decimals, and fractions.
3. Convert numbers between forms expressed as fractions, decimals, and percents.
4. Apply basic Geometry/Trigonometry for problem-solving.
5. Convert between standard American units of measure.
6. Convert between standard American units and metric units.
7. Demonstrate the use of mathematical charts, tables, and formula.
8. Apply appropriate mathematical SW programs.

TASK INVENTORY

INSTRUCTIONS: Listed on the following pages are the duties and tasks related to manufacturing occupations. Across the top to the right are listed the job titles related to manufacturing which are being considered by this committee. Rank each task as:
"E" for Entry (a skill required to obtain the job),
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DUTY NO.	TASK NO.	TASK	TRAINEE	PRECISION GEN. MACHINIST	TOOL & DIE MAKER	MOLDMAKER	AUTOMATED MFG. MACHINIST	MAINTENANCE MACHINIST	SUPERVISOR
A.		OPERATING LATHES							
	1.	Use steady rests.	A	E	E	E	E	E	E
	2.	Plan sequence of operations.	A	R	R	R	R	R	R
	3.	Perform basic maintenance.	E	R	R	R	R	R	E
	4.	Identify machine problems and correct them.	A	R	R	R	R	R	R
	5.	Grind parts with tool post grinder, OD/ID.	A	R	R	R	R	R	R
	6.	Turn radii.	A	R	R	R	R	R	R
	7.	Use follower rest.	A	R	R	R	R	R	R
	8.	Cut special thread forms.	A	R	R	R	R	R	R
	9.	Thread external/internal diameters.	A	E	E	E	E	E	E
	10.	Repair threads.	A	E	E	E	E	E	E
	11.	Set taper cuts.	A	R	E	E	E	E	E
	12.	Align lathe centers.	R	E	E	E	E	E	E
	13.	Cut off parts.	R	E	E	E	E	E	E
	14.	Manufacture springs.	A	A	R	R	R	R	R
	15.	Machine essentric diameters.	A	R	R	R	R	R	R
	16.	Undercut diameters and shoulders.	R	R	R	E	R	R	E
	17.	Ream holes.	R	E	E	E	E	E	E
	18.	Recess internal diameters.	A	E	E	E	E	E	E
	19.	Face internal diameters.	R	E	E	E	E	E	R
	20.	Bore internal diameters.	R	E	E	E	E	E	E
	21.	Machine parts on faceplates.	R	E	E	E	E	E	E
	22.	Machine parts in collet chucks.	R	E	E	E	E	E	E
	23.	Machine parts in four-jaw chuck.	R	E	E	E	E	E	E
	24.	Machine parts between centers.	R	E	E	E	E	E	E
	25.	Align, face, and turn parts in three-jaw chuck.	R	E	E	E	E	E	E
	26.	Maintain coolant systems.	R	E	E	E	E	E	E
	27.	Set operating conditions.	R	E	E	E	E	E	E
	28.	Select proper turning tools.	R	E	E	E	E	E	E

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DUTY NO.	TASK NO.	TASK	TRAINEE	PRECISION GEN. MACHINIST	TOOL & DIE MAKER	MOLDMAKER	AUTOMATED MFG. MACHINIST	MAINTENANCE MACHINIST	SUPERVISOR
B.		PERFORMING HOLE-FORMING OPERATIONS							
	1.	Plan sequence of operations.	A	R	R	R	R	R	R
	2.	Maintain boring machine.	A	R	R	R	R	R	R
	3.	Locate and solve machine problems.	A	R	R	R	R	R	R
	4.	Recess internal surfaces.	A	R	E	E	R	R	E
	5.	Face internal surfaces.	A	R	E	E	R	R	E
	6.	Bore internal surfaces.	A	R	R	R	R	R	R
	7.	Tap holes on machine.	R	R	R	R	R	R	R
	8.	Establish zero reference.	R	R	R	R	R	R	R
	9.	Set operating conditions.	A	R	R	R	R	R	R
C.		PERFORMING DRILLING OPERATIONS							
	1.	Counter sink parts.	A	E	E	E	E	E	E
	2.	Centerdrill and drill holes.	R	E	E	E	E	E	E
	3.	Align workpieces.	E	E	E	E	E	E	E
	4.	Change drills and holders.	R	E	E	E	E	E	E
	5.	Select drills.	A	E	E	E	E	E	E
	6.	Plan sequence of operations.	A	R	R	R	R	R	R
	7.	Maintain drilling machine.	R	R	R	R	R	R	R
	8.	Sharpen drills.	R	R	R	R	R	R	R
	9.	Drill holes at angle.	A	R	R	R	R	R	R
	10.	Burnish holes.	A	R	R	R	R	R	R
	11.	Ream holes to size.	A	R	R	R	R	R	R
	12.	Drill holes with special drills.	R	R	R	R	R	R	R
	13.	Drill holes to specified depth.	R	R	R	R	R	R	R
	14.	Spot-face parts.	R	R	R	R	R	R	R
	15.	Counter bore parts.	A	R	R	R	R	R	R
	16.	Set operating conditions.	E	E	E	E	E	E	E
D.		PERFORMING CUT-OFF OPERATIONS							
	1.	Plan sequence of sawing operations.	A	R	R	R	R	R	R
	2.	Clean, lubricate saw and maintain saw coolant system.	A	E	E	E	E	E	E

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DUTY NO.	TASK NO.	TASK	TRAINEE	PRECISION GEN. MACHINIST	TOOL & DIE MAKER	MOLDMAKER	AUTOMATED MFG. MACHINIST	MAINTENANCE MACHINIST	SUPERVISOR
	3.	File parts on bandsaw.	R	E	R	R	E	R	R
	4.	Saw miscellaneous contours.	A	E	E	E	E	E	E
	5.	Saw contours--internal.	R	R	E	R	R	R	E
	6.	Saw contours--exterior.	R	R	E	R	R	R	E
	7.	Saw to scribed line--straight.	R	E	E	E	E	E	E
	8.	Select speeds and feeds for sawing.	R	E	E	E	E	E	E
	9.	Cut and weld bandsaw blades.	R	E	E	E	E	E	E
	10.	Replace saw blades.	R	E	E	E	E	E	E
E.		PERFORMING LAYOUTS							
	1.	Transfer layouts from model.	A	R	R	R	R	R	R
	2.	Layout reference points.	A	R	R	R	R	R	R
	3.	Layout angles, arc, and locations from reference points.	A	R	R	R	R	R	R
	4.	Calculate reference points.	A	R	R	R	R	R	R
	5.	Plan layout operations.	A	R	R	R	R	R	E
	6.	Compute layout dimensions.	A	R	R	R	R	R	R
	7.	Analyze layout specifications.	A	R	R	R	R	A	R
F.		PERFORMING PRECISION MEASUREMENT							
	1.	Inspect assemblies.	A	R	R	R	R	R	R
	2.	Verify clearances.	A	R	R	R	R	R	R
	3.	Verify alignments.	A	R	R	R	R	R	R
	4.	Monitor reports.	A	R	R	R	R	R	R
	5.	Inspect parts according to Quality Control.	R	R	R	R	R	R	R
	6.	Perform first-piece inspection.	R	R	R	R	R	R	R
	7.	Calibrate precision measuring tools (i.e., optical comparator).	A	R	R	R	R	R	R
	8.	Calibrate micrometers.	A	E	E	E	E	E	E
	9.	Measure gears.	A	R	R	R	R	R	E
	10.	Measure keyseat.	A	R	R	R	R	E	E
	11.	Measure tapers.	A	R	R	R	R	R	R

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	12.	Measure threads.	R	E	E	E	E	E	E
	13.	Measure angles, arc, and locations from reference point.	A	R	R	R	R	R	E
	14.	Measure angles using sine bar.	A	R	E	E	E	E	E
	15.	Measure parts with height gauge.	R	E	E	E	R	R	E
	16.	Measure parts using optical comparators.	A	R	R	R	R	R	R
	17.	Inspect parts with comparison measuring tools.	R	R	R	R	R	R	E
	18.	Inspect parts with precision measuring tools.	E	E	E	E	E	E	E
	19.	Measure parts with semi-precision measuring tools.	E	E	E	E	E	E	E
G.		PERFORMING BENCHWORK							
	1.	Supervise assembly operations.	A	A	A	A	A	A	R
	2.	Plan assembly operations.	A	A	R	R	A	A	R
	3.	Repair hand tools.	A	A	A	A	A	R	E
	4.	Assemble and repair gauges.	A	A	A	R		R	E
	5.	Repair cutting tools.	A	R	E	E	R	R	E
	6.	Assemble cutting tools.	A	R	E	E	E	R	E
	7.	Repair metalworking dies.	A	A	A	R	A	A	A
	8.	Fit and assemble metalworking dies.	A	R	R	E	R	R	R
	9.	Repair jigs and fixtures.	A	R	R	R	R	R	R
	10.	Assemble jigs and fixtures.	A	R	E	R	R	R	R
	11.	Lift and position workpiece.	R	E	E	E	E	E	E
	12.	Apply specified surface in hole (hand ream).	A	R	R	R	R	R	E
	13.	Cut keyways using hand broaching tools.	A	R	R	R	R	R	E
	14.	Straighten parts.	E	E	E	E	E	E	E
	15.	Lap and fit parts.	R	R	R	R	R	R	R
	16.	Remove high spots.	E	E	E	R	R	R	R
	17.	Determine high spots.	E	E	E	R	R	R	R

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	18.	Finish parts with hand grinders.	E	R	R	R	R	R	R
	19.	Rough grinding parts with hand grinders.	E	R	R	R	R	R	R
	20.	Use hand filing machines to rough finish parts.	E	E	E	R	R	R	E
	21.	Sharpen and polish tools.	E	R	R	R	R	R	R
	22.	Polish parts.	E	E	R	R	R	R	R
	23.	Deburring parts.	E	E	E	E	E	E	E
	24.	Remove damaged fasteners and repair threads.	E	E	R	R	R	R	E
	25.	Cut threads with hand taps and dies.	E	E	E	E	A	R	E
H.		OPERATING MILLS							
	1.	Locate and mill a pocket in the part.	A	R	E	E	R	R	E
	2.	Establish zero reference point.	R	E	E	E	E	E	E
	3.	Align milling fixtures with an indicator.	R	E	E	E	E	E	E
	4.	Align vertical head.	R	E	E	E	E	E	E
	5.	Set operating conditions.	R	R	R	R	R	R	E
	6.	Select proper milling cutters.	R	R	R	R	R	R	E
	7.	Machine angles.	A	R	R	R	R	R	R
	8.	Machine radii.	A	R	R	R	R	R	R
	9.	Machine various slots.	A	E	E	E	E	E	E
	10.	Center drill and drill holes.	E	E	E	E	E	E	E
	11.	Drill and ream holes.	E	E	E	E	E	E	E
	12.	Tap holes.	R	E	E	E	E	E	E
	13.	Bore diameters.	A	R	E	E	E	E	R
	14.	Face parts with offset boring head.	A	R	E	E	E	E	E
	15.	Recess faces or diameters with offset boring heads.	A	E	E	E	E	E	E
	16.	Perform indexing operations.	A	R	R	R	R	R	R
	17.	Identify and correct mill problems.	A	R	R	R	R	R	R
	18.	Maintain milling machine.	R	E	E	E	E	E	E

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	19.	Plan sequence of operations.	A	R	R	R	R	R	E
	20.	Change arbors and cutters.	R	E	E	E	E	E	E
	21.	Perform horizontal milling operations.	A	R	R	R	R	R	R
	22.	Mill parts square.	R	E	E	E	E	E	R
	23.	Calculate and machine gears.	A	R	R	R	R	R	R
I.		OPERATING GRINDERS-SURFACE							
	1.	Set operating conditions.	A	R	R	R	R	R	R
	2.	Select, change, and dress grinding wheels.	A	R	E	E	R	R	E
	3.	Grind tools, sharpen and recondition.	R	E	E	E	E	E	E
	4.	Sharpen carbide tools.	A	R	E	E	R	E	E
	5.	Grind parallel surfaces.	A	R	E	E	E	E	E
	6.	Grind parts square on the surface grinder.	A	R	E	E	E	E	E
	7.	Grind vertical surfaces.	A	R	E	E	E	E	E
	8.	Grind angles and radii on surface grinders.	A	R	E	E	R	R	E
	9.	Cut off parts.	A	E	E	E	E	E	E
	10.	Plan sequence of operations.	A	R	E	E	E	E	E
J.		OPERATING GRINDERS I.D.							
	1.	Grind inside diameters on I.D. grinder.	A	R	E	E	R	E	E
	2.	Grind to shoulder.	A	R	E	E	R	R	E
	3.	Grind to taper.	A	R	R	R	R	R	R
	4.	Grind internal radius.	A	R	R	R	R	R	R
	5.	Grind recess.	A	R	R	R	R	R	R
	6.	Grind internal angle.	A	R	R	R	R	R	R
	7.	Set operating conditions.	A	R	R	R	R	R	R
	8.	Plan sequence of operations.	A	R	E	E	E	E	E

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K.		OPERATING GRINDERS-O.D.							
	1.	Align grinder head, table, and footstock.	A	R	E	E	E	E	E
	2.	Grind outside diameters.	A	R	E	E	E	E	E
	3.	Grind to shoulder.	A	E	E	E	E	E	E
	4.	Grind taper.	A	R	E	E	R	R	E
	5.	Grind radius.	A	R	R	R	R	R	E
	6.	Grind angle.	A	R	R	R	R	R	E
	7.	Plunge grind O.D.	A	R	E	E	E	E	E
	8.	Set operating conditions.	A	E	E	E	E	E	E
	9.	Plan sequence of operation.	A	R	E	E	E	E	E
L.		OPERATING GRINDERS/TOOL							
	1.	Set operating conditions.	A	E	E	E	E	E	E
	2.	Grind end mills.	A	R	E	E	R	R	E
	3.	Grind helical cutters.	A	R	R	R	R	R	R
	4.	Grind angular cutters.	A	R	R	R	R	R	R
	5.	Grind step drills.	A	R	R	R	R	R	R
	6.	Grind reamers.	A	R	R	R	R	R	R
	7.	Sharpen taps.	A	R	R	R	R	R	R
	8.	Grind assorted cutters and tools.	R	R	E	E	E	E	E
	9.	Grind form tools.	A	R	R	R	R	R	R
	10.	Identify and correct grinder problems.	A	R	R	R	R	R	R
	11.	Plan sequence of operation.	A	R	E	E	E	E	E
M.		OPERATING E.D.M. (Electrical Discharge Machines)							
	1.	Maintain machine electrodes.	A	R	R	R	R	R	R
	2.	Mount electrode in holder.	A	R	R	R	R	R	R
	3.	Position workpiece.	A	R	R	R	R	R	R
	4.	Align work and check clearances.	A	R	R	R	R	R	R
	5.	Set operating conditions.	A	R	R	R	R	R	R
	6.	Perform internal cuts (burns).	A	R	R	R	R	R	R
	7.	Perform external cuts.	A	R	R	R	R	R	R

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	8.	Perform repair work.	A	R	R	R	R	R	R
	9.	Identify and solve machine problems.	A	R	R	R	R	R	R
	10.	Perform basic maintenance.	A	R	E	E	R	R	R
	11.	Plan sequence of operations.	A	R	R	R	R	R	R
N.		PERFORMING HEAT TREATMENT OPERATIONS							
	1.	Test hardness of metal.	R	R	E	E	R	E	E
	2.	Perform non-destructive testing.	R	R	R	R	A	R	R
	3.	Perform destructive testing.	A	R	R	R	R	R	R
	4.	Harden metal.	A	R	R	R	R	R	R
	5.	Temper metals.	A	R	R	R	R	R	R
	6.	Anneal metals.	A	R	R	R	R	R	R
	7.	Normalize metals.	A	R	R	R	R	R	R
	8.	Case harden metals.	A	R	R	R	R	R	R
	9.	Pre and post heat metals.	A	R	R	R	R	R	R
	10.	Plan sequence of operations.	A	A	E	E	A	E	E
O.		OPERATING NC/CNC							
	1.	Determine operating conditions.	A	R	R	R	R	R	R
	2.	Set up machine.	A	R	R	R	R	R	R
	3.	Run machine parts with CNC.	A	R	R	R	E	A	R
	4.	Enter program through MDI.	A	A	R	R	R	A	R
	5.	Modify MDI program.	A	A	R	R	R	A	R
	6.	Execute emergency stop.	R	R	R	R	R	R	R
	7.	Plan sequence of operations.	A	A	A	A	E	A	E
P.		ASSEMBLE AND DISASSEMBLE MECHANISMS							
	1.	Install and maintain belt drive.	E	A	A	A	A	E	E
	2.	Install and maintain chain drive.	A	A	A	A	A	R	R
	3.	Install and maintain gear drives.	A	A	A	A	A	R	R
	4.	Install and/or repair variable drives.	A	A	A	A	A	R	R
	5.	Install and maintain couplings.	A	A	A	A	A	R	R
	6.	Replace and pack seals.	A	R	R	R	R	E	E

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	7.	Install and align bearings.	A	A	A	A	A	R	R
	8.	Maintain and repair shafting.	A	A	A	A	A	R	R
	9.	Maintain and repair mechanisms.	A	A	A	A	A	R	R
	10.	Repair clutches.	A	A	A	A	A	R	R
	11.	Install and maintain conveyors.	A	A	A	A	A	E	R
	12.	Plan sequence of operations.	A	A	A	A	A	E	A
Q.		INSTALLING AND REMOVING MACHINERY							
	1.	Prepare areas for machine installation.	A	R	R	R	R	E	E
	2.	Raise machinery using jacks, bars, and blocks.	A	R	R	R	R	R	E
	3.	Move machinery using forklift slings, skids, and dollies.	A	R	R	R	R	R	E
	4.	Move machinery using overhead crane and/or chain hoist.	A	R	R	R	R	R	E
	5.	Install machinery, position, level, align, and test.	A	A	A	A	A	R	R
	6.	Balance machinery.	A	A	A	A	A	E	R
	7.	Connect machinery to air or hydraulic source.	A	A	A	A	A	E	R
	8.	Block, brace, and crib equipment for moving.	A	A	A	A	A	E	R
	9.	Plan a sequence of operations.	A	A	A	A	A	E	E
R.		MAINTAIN HYDRAULIC SYSTEMS							
	1.	Troubleshoot systems.	A	A	A	A	A	R	R
	2.	Perform preventative maintenance.	A	A	A	A	A	R	R
	3.	Perform basic repair.	A	A	A	A	A	R	R
	4.	Perform tests on systems.	A	A	A	A	A	R	R
	5.	Measure pressure and flow.	A	A	A	A	A	R	R
	6.	Inspect parts of systems.	A	A	A	A	A	R	R

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S.		MAINTAIN PNEUMATIC SYSTEMS							
	1.	Troubleshoot pneumatic system.	A	A	A	A	A	R	R
	2.	Perform preventative maintenance.	A	A	A	A	A	R	R
	3.	Install or replace components.	A	A	A	A	A	R	R
	4.	Repair components and air leaks.	A	A	A	A	A	R	R
	5.	Inspect parts and system.	A	A	A	A	A	R	R
	6.	Measure air pressure.	A	A	A	A	A	R	R
T.		MAINTAIN ELECTRONIC CONTROL SYSTEMS							
	1.	Troubleshoot control systems.	A	A	A	A	A	A	A
	2.	Perform preventative maintenance.	A	A	A	A	A	A	A
	3.	Perform adjustments on control systems.	A	A	A	A	A	A	A
	4.	Interpret control diagrams.	A	A	A	A	A	A	A
U.		MAINTAIN AUTOMATED SYSTEMS							
	1.	Troubleshoot system components.	A	A	A	A	A	A	A
	2.	Adjust system.	A	A	A	A	A	A	A
	3.	Apply service bulletin requirements.	A	A	A	A	A	A	A
	4.	Disassemble repair and test system.	A	A	A	A	A	A	A
	5.	Maintain automated systems.	A	A	A	A	A	A	A
V.		INSTALL AUTOMATED SYSTEMS							
	1.	Install robots.	A	A	A	A	A	A	A
	2.	Install workcell.	A	A	A	A	A	A	A
	3.	Test automated system.	A	A	A	A	A	A	A
	4.	Measure robot performance.	A	A	A	A	A	A	A
	5.	Troubleshoot system.	A	A	A	A	A	A	A
	6.	Optimize system.	A	A	A	A	A	A	A
	7.	Plan and design system.	A	A	A	A	A	A	A
	8.	Adjust system.	A	A	A	A	A	A	A
	9.	Start system and shut down system.	A	A	A	A	A	A	A

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W.		PROGRAMMING AND PLANNING							
	1.	Write a CNC program.	A	A	A	A	R	A	A
	2.	Program with integrated graphic programming system.	A	A	A	A	R	A	A
	3.	Design fixturing and clamping.	A	A	A	A	A	A	A
	4.	Update programs from engineering changes.	A	A	A	A	R	A	A
	5.	Schedule programs and second operations.	A	A	A	A	A	A	R
X.		PERFORMING OPERATING FUNCTIONS OF AUTOMATED SYSTEM							
	1.	Assist in implementation plan.	A	A	A	A	R	R	E
	2.	Determine resources.	A	A	A	A	A	A	R
	3.	Coordinate within and outside department.	A	R	R	R	R	R	E
Y.		PERFORM COMMUNICATION FUNCTIONS							
	1.	Prepare reports.	A	A	A	A	A	A	R
	2.	Make presentations.	A	A	A	A	A	A	R
	3.	Interface with vendors.	A	A	A	A	A	A	R
	4.	Demonstrate equipment.	A	A	A	A	A	A	R
	5.	Conduct training.	A	A	A	A	A	A	R
Z.		PERFORMING QUALITY CONTROL/QUALITY ASSURANCE							
	1.	Develop standards.	A	A	A	A	A	A	R
	2.	Implement standards and procedures.	A	A	A	A	A	A	R
	3.	Conduct quality tests.	A	A	A	A	A	A	R
	4.	Calibrate equipment.	A	A	A	A	A	A	R
	5.	Apply statistical control process.	A	R	A	A	R	A	R
	6.	Integrate quality engineering.	A	A	A	A	A	A	R

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AA.		PERFORM HOUSEKEEPING/RECORDKEEPING							
	1.	Clean and maintain work area.	E	E	E	E	E	E	E
	2.	Clean and store tools and tooling.	E	E	E	E	E	E	E
	3.	Inspect guarding.	R	E	E	E	E	E	E
	4.	Paint machines.	E	E	E	E	E	E	E
	5.	Report problems to supervisor.	E	E	E	E	E	E	E
	6.	Complete forms.	E	R	R	R	R	R	E
	7.	Read job orders and process sheets.	E	E	E	E	E	E	E
	8.	Determine basic maintenance procedures.	A	R	R	R	R	R	R
BB.		PERFORM SUPERVISORY FUNCTIONS							
	1.	Determine availability of resources.	A	A	A	A	A	A	E
	2.	Secure resources.	A	A	A	A	A	A	E
	3.	Coordinate personnel.	A	A	A	A	A	A	E
	4.	Maintain records.	A	A	A	A	A	A	E
	5.	Review work orders.	A	A	A	A	A	A	E
	6.	Issue work orders.	A	A	A	A	A	A	E
	7.	Write reports.	A	A	A	A	A	A	E
	8.	Perform inventory functions.	A	A	A	A	A	A	E
	9.	Conduct inspection activities.	A	A	A	A	A	A	E
	10.	Monitor discrepancy reports.	A	A	A	A	A	A	E
	11.	Initiate part change notices.	A	A	A	A	A	A	E
	12.	Supervise plant and personnel.	A	A	A	A	A	A	E
	13.	Coordinate maintenance.	A	A	A	A	A	A	E
	14.	Plan and coordinate training.	A	A	A	A	A	A	E
	15.	Follow-up problem reports.	A	A	A	A	A	A	E
	16.	Manage personnel policies in plant.	A	A	A	A	A	A	E
	17.	Contract for outside work.	A	A	A	A	A	A	E
	18.	Conduct meetings.	A	A	A	A	A	A	E
	19.	Make estimates.	A	A	A	A	A	A	E
	20.	Supervise assembly operations.	A	A	A	A	A	A	E

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CC.		DEMONSTRATE INDUSTRIAL SAFETY STANDARDS							
	1.	Comply with safety and health rules.	E	E	E	E	E	E	E
	2.	Select and utilize tools and equipment correctly.	E	E	E	E	E	E	E
	3.	Participate in disaster control and emergency exercises.	E	E	E	E	E	E	E
	4.	Maintain clean and orderly work area.	E	E	E	E	E	E	E
	5.	Participate in company safety training program.	E	E	E	E	E	E	E

PERFORMANCE OBJECTIVES & GUIDES

FOR

MANUFACTURING OCCUPATIONS

DUTY A: OPERATING LATHES

1. TASK: Use steady rests

PERFORMANCE OBJECTIVE

Provided with part, drawing, lathe and accessories, machine part using a steady rest. Part will meet tolerance of + or - 0.001" and/or drawing specs.

TOOLS AND EQUIPMENT

Lathe
Lubricant
Steady rest
Layout fluid
Lathe tools

PERFORMANCE GUIDE

1. Mount part in lathe.
2. Adjust steady rest for part.
3. Locate rest and clamp part.
4. Raise two lower jaws to touch work and finger tighten clamp bolt.
5. Apply pressure lubricant on jaws.
6. Lock all jaws.
7. Adjust upper jaw during cut for expansion of part.
8. Use soft shims or jaws for machined part.

DUTY A: OPERATING LATHES

2. TASK: Plan sequence of operations

PERFORMANCE OBJECTIVE

Furnished with drawing, plan a sequence of operations to machine part on lathe.

TOOLS AND EQUIPMENT

Drawing
Word processor
Pencil

PERFORMANCE GUIDE

1. Review drawing.
2. Sequence operations.
3. Optimize tools and operations.
4. Review sequence.
5. Record on operations form.

DUTY A: OPERATING LATHES

3. TASK: Perform basic maintenance

PERFORMANCE OBJECTIVE

Furnished with a lathe, manuals, and lubricant, perform basic maintenance and adjustments.

TOOLS AND EQUIPMENT

Lathe
Assorted tools
Machine lube

PERFORMANCE GUIDE

1. Read manual for maintenance requirements.
2. Make all adjustments on gibs and bearings.
3. Lubricate oil cups, and grease where needed.
4. Clean properly.
5. Record work done in maintenance record.

DUTY A: OPERATING LATHES

4. TASK: Identify machine problems, and correct problems

PERFORMANCE OBJECTIVE

Furnished with a lathe, identify and correct problems as they happen. Follow manufacturers manuals.

TOOLS AND EQUIPMENT

Lathe
Assorted tools
Manuals

PERFORMANCE GUIDE

1. Troubleshoot sounds and problems.
2. Log problems.
3. Correct problems.
4. Record maintenance.
5. Report problems you are unable to correct.

DUTY A: OPERATING LATHES

5. TASK: Grind parts with toolpost grinder, OD/ID

PERFORMANCE OBJECTIVE

Provided with part and drawing, lathe and accessories, grind part with tool post grinder. Meet tolerances of 0.0005" + or -.

TOOLS AND EQUIPMENT

Lathe
Tool post grinder
Wheel
Diamond dresser
Micrometer
Cloth

PERFORMANCE GUIDE

1. Select grinder wheel.
2. Mount grinder on lathe.
3. Check wheel for cracks.
4. Cover ways.
5. Mount part in lathe.
6. Dress wheel.
7. Calculate speeds; 80-100rpm.
8. Set feed; 0.005"-0.007".
9. Turn on lathe.
10. Engage part and grinder; 0.001" to 0.008" deep.
11. Engage longitudinal feed.
12. Measure part.
13. Check for taper, adjust out as needed.
14. Continue light cuts to finish.
15. Repeat steps as necessary to complete part to size.

DUTY A: OPERATING LATHES

6. TASK: Turn radii

PERFORMANCE OBJECTIVE

Provided with part, drawing, tooling, machine radii on part with compound rest or form tool. Radii must meet tolerance of + or - 0.005", fit radius gage, and/or meet drawing specs.

TOOLS AND EQUIPMENT

Lathe
Tooling
Wrenches
Radius gage
Layout fluid
Scribe
Steel rule

PERFORMANCE GUIDE

1. Check drawing for size and position.
2. Mount part in lathe.
3. Layout radius position.
4. Install tooling.
5. Locate point or position of tool from compound center swivel point.
6. Locate carriage and lock.
7. Loosen lock bolts on compound.
8. Start lathe.
9. Move tool with crossfeed.
10. Touch part.
11. Swing compound in cut direction.
12. Return to beginning of arc and infeed 0.020" with crossfeed.
13. Swing slowly across cut.
14. Measure radius.
15. Make adjustments as necessary to carriage.
16. Continue light cuts to finish.
17. Radius turning attachment.

DUTY A: OPERATING LATHES

7. TASK: Use follower rest

PERFORMANCE OBJECTIVE

Provided drawing, long part, machine tool, and accessories, machine spindly part with follower rest. Part will be concentric to + or - 0.0005", and within tolerance of + or - 0.001" or drawing specs.

TOOLS AND EQUIPMENT

Lathe
Part
Follower rest
Measuring tools

PERFORMANCE GUIDE

1. Set up operating conditions for material and part size.
2. Mount part in lathe.
3. Set up tool.
4. Install follower rest behind part opposite the turning tool.
5. Take a trial cut.
6. Lubricate rest at contact to pick up next diameter.
7. Adjust rest with each pass to pick up next diameter.
8. Finish part.
9. Inspect for size and finish, concentricity.

DUTY A: OPERATING LATHES

8. TASK: Cut special thread forms

PERFORMANCE OBJECTIVE

Provided with drawing, lathe, and part(s), cut any one of the special thread forms: Multiple lead, Acme, Square, Buttress, Metric, etc. Thread must meet standards of shape and fit for thread form, and must be within thread class tolerance.

TOOLS AND EQUIPMENT

Part(s)
Lathe
Assorted threading tools
Measuring tools
Assorted tools
Cutting fluid
Center gages
Special thread gages

PERFORMANCE GUIDE

1. Mount work piece between centers or in a chuck.
2. Set gearbox.
3. Adjust operating conditions, slow rpm.
4. Install tool for certain thread form.
5. Establish zero reference.
6. Calculate depth.
7. Make roughing passes.
8. Measure thread.
9. Make finish passes.
10. File or hone.
11. Inspect thread.

DUTY A: OPERATING LATHES

9. TASK: Thread external/internal diameters

PERFORMANCE OBJECTIVE

Provided with part, drawing, lathe, chase threads. The threads must be cut to drawing specs. The threads must fit go and no go gages or meet standards with thread wires.

TOOLS AND EQUIPMENT

Lathe
Lathe dog
Center gage
Cutting fluid
Micrometer
Charts

Centers
Threading tool
Screw pitch gage
Go and no go gages
Thread wires

PERFORMANCE GUIDE

1. Set up part.
2. Select operating conditions.
3. Align tool to work with center gage.
4. Apply bluing.
5. Set lathe gears to desired pitch thread.
6. Take trial cut and check with screw pitch gage.
7. Set and stops needed.
8. Start roughing cuts.
9. Measure thread with wires or go/no go gage.
10. Take finish passes; 0.005" to 0.001".
11. Let tool take one or two spring passes until no cutting is taking place.
12. Take final measurements.
13. Deburr, clean, and inspect.

DUTY A: OPERATING LATHES

10. TASK: Repair threads

PERFORMANCE OBJECTIVE

Provided with part(s) with damaged threads, drawing, repair thread as necessary.

TOOLS AND EQUIPMENT

Lathe
Threading tool
Thread pitch gage
Thread files
Welder, if needed
Center gage (fishtail)

PERFORMANCE GUIDE

1. Determine needed repair.
2. Weld up thread, if needed.
3. Turn down thread, as needed.
4. Use thread file on damaged threads.
5. Re-cut threads after welding.
6. Chase current threads with lathe to clean up thread.
7. Or turn down thread area, sleeve area, re-cut thread.
8. Inspect thread.

DUTY A: OPERATING LATHES

11. TASK: Set taper cuts

PERFORMANCE OBJECTIVE

Provided with lathe, part, taper attachment, drawings, set and cut external and internal tapers. Part must be within tolerance of drawing and/or fit go/no go gage.

TOOLS AND EQUIPMENT

Lathe
Cutting tool
Centerdrill
Go and no go gage
Steel rule
Taper attachment
Files
Drill chuck
Micrometer

PERFORMANCE GUIDE

1. Chuck part.
2. Determine taper from drawing.
3. Set taper per inch on taper attachment.
4. Check taper set with indicator.
5. Set up tooling.
6. Take trial cut, engage feed ½" before end of part.
7. Measure with O.D. micrometer, dial indicator, taper mic, taper ring gage.
8. Take finish passes.
9. Mark with bluing areas needing filing.
10. File to fit gage or taper measured.

12. TASK: Align lathe centers

PERFORMANCE OBJECTIVE

Provided with lathe and measuring tools, align the lathe centers. Centers must be aligned to tolerance of + or - 0.0005" or closer.

TOOLS AND EQUIPMENT

Lathe
Test bar
Centers
Dial indicator
Wrenches

PERFORMANCE GUIDE

1. Clean centers and spindle holes.
2. Mount centers.
3. Check alignment of center in headstock.
4. Rework as needed.
5. Clean center holes on test bar.
6. Check alignment marks on tailstock.
7. Mount test bar.
8. Attach indicator to tool post.
9. Check indicator against bar.
10. Set indicator to zero at one end of bar.
11. Move carriage to other end of bar.
12. Read any variations.
13. Make any adjustments to tailstock, ½ of readout.
14. Run test again, as necessary, until in line.

DUTY A: OPERATING LATHES

13. TASK: Cut off parts

PERFORMANCE OBJECTIVE

Provided with part(s), lathe, lathe tooling, and drawing, cut off parts (parting) in the lathe to specified length and thickness. Part must meet drawing specifications.

TOOLS AND EQUIPMENT

Lathe
Measuring tools
Cutting fluid
Parting tool
Dial indicator
Part(s)

PERFORMANCE GUIDE

1. Determine part length (thickness).
2. Set up parting tool perpendicular to work.
3. Determine and set operating conditions.
4. Set parting tool to end of cut (length of part) with steel rule, if tolerances permit.
5. Or touch off end with tool, set up dial travel indicator against carriage.
6. Dial over carriage plus tool width plus any allowances for finish or grinding.
7. Start cut applying cutting fluid liberally.
8. As parting tool nears end of cut, stop feed and gently feed by hand. Insert catch rod in end, if part board to catch part.
9. If part is too large, stop cut before part severs, cradle part, and wedge off or knock off.
10. Debur, clean, and inspect.

DUTY A: OPERATING LATHES

14. TASK: Manufacture springs

PERFORMANCE OBJECTIVE

Provided with tooling, spring steel wire, charts, make a spring. Spring shall meet specifications.

TOOLS AND EQUIPMENT

Lathe
Spring steel
Machinery's handbook
Spring arbor
Charts

PERFORMANCE GUIDE

1. Determine pitch of spring.
2. Set up mandril between centers.
3. Install and align spring guide.
4. Set speed at slow rpm and pitch of spring as to thread pitch.
5. Put wire through guide and into hole in arbor.
6. Apply pressure lubricant.
7. Turn on lathe and guide wire through guide.
8. Shut off lathe.
9. Remove arbor and remove spring.
10. Cut or grind spring to desired length.

DUTY A: OPERATING LATHES

15. TASK: Machine eccentric diameters

PERFORMANCE OBJECTIVE

Provided with part, drawing, measuring tools, and layout tools, machine eccentric diameters. Part must meet tolerance of + or - 0.002" or drawing specs.

TOOLS AND EQUIPMENT

Lathe
Punch
Vee block
Four jaw chuck

Centerhead
Dividers
Measuring tools

PERFORMANCE GUIDE

1. Determine offset of eccentric.
2. Layout offset.
3. Centerpunch offset center distance.
4. Chuck in lathe, softly.
5. Set dial indicator against part.
6. Set tailstock center up to part.
7. Offset distance with chuck jaws, and align with center.
8. Set up tooling.
9. Set speeds and feeds.
10. Take trial cuts.
11. Measure part to drawing.
12. Finish part.
13. Inspect and measure part to drawing specs.

DUTY A: OPERATING LATHES

16. TASK: Undercut diameters and shoulders

PERFORMANCE OBJECTIVE

Provided with part, lathe and accessories, drawing, select tool and undercut diameters and shoulders. Part must meet tolerance of + or - 0.002" or drawing specifications.

TOOLS AND EQUIPMENT

Lathe
Assorted tools
Hone
Special ground tool
Measuring tools

PERFORMANCE GUIDE

1. Select and sharpen tool bit for undercuts.
2. Align tool to part and tool holder.
3. Select speeds and feeds.
4. Apply cutting fluid liberally.
5. Set machine dials to zero reference.
6. Cut part.
7. Clean and inspect part.
8. Check drawing tolerances.

DUTY A: OPERATING LATHES

17. TASK: Ream holes

PERFORMANCE OBJECTIVE

Provided with part drawing, part(s), lathe and accessories, and measuring tools, ream hole in the part(s). Hole tolerances are + 0.0005" and - 0.000".

TOOLS AND EQUIPMENT

Lathe
Drills
Reamers
Micrometer
Drill chuck and key
Plug gage
Work holding parts
Centerdrill
Vernier caliper
Cutting fluid
Machinery's handbook

PERFORMANCE GUIDE

1. Determine part material.
2. Set appropriate speeds and feeds for all tools.
3. Mount and center part, and check for center alignment.
4. Install drill chuck and centerdrill.
5. Centerdrill part.
6. Drill hole.
7. Select reamer.
8. Ream hold applying cutting fluid liberally.
9. Measure hole with plug gage.

DUTY A: OPERATING LATHES

18. TASK: Recess internal diameters

PERFORMANCE OBJECTIVE

Provided with part already bored and faced, drawing, tooling, and lathe, recess internal diameter (face). Part must meet tolerance of + or - 0.001" or drawing specs.

TOOLS AND EQUIPMENT

Lathe	Chuck
Measuring tools	Boring bar
Special group recessing tool	

PERFORMANCE GUIDE

1. Set up part.
2. Align part.
3. Place special tool in boring bar 45 degree slot.
4. Determine placement of recess.
5. Set zero reference on machine dials.
6. Set stops, speeds, and feeds.
7. Apply cutting fluid.
8. Cut recess.
9. Inspect and measure part(s).

DUTY A: OPERATING LATHES

19. TASK: Face internal diameters

PERFORMANCE OBJECTIVE

Provided with part(s), lathe and tooling, set up and face internal diameters (faces). Part must meet drawing specs, and tolerances of + or - 0.002".

TOOLS AND EQUIPMENT

Lathe
Part
Measuring tools
Chuck
Boring bar and tool

PERFORMANCE GUIDE

1. Mount part in chuck.
2. Align, if not in alignment.
3. Bore hole/counterbore hold.
4. Use tool mounted in 45 degree slot to face counterbore.
5. Set stops for final depth.
6. Face part to stop.
7. Inspect part to drawing specs.

DUTY A: OPERATING LATHES

20. TASK: Bore internal diameters

PERFORMANCE OBJECTIVE

Provided with lathe, part(s), drawing, measuring tools, bore (counterbore) part to specifications. Bore must meet tolerances of + or - 0.001" or drawing tolerances.

TOOLS AND EQUIPMENT

Lathe
Faced stock with drilled hole
Telescoping gage
Boring tool
Steel rule
Chuck
Boring bar
Micrometer
Depth micrometer

PERFORMANCE GUIDE

1. Mount part in the lathe.
2. Install boring bar.
3. Select largest possible bar and grip shortest possible.
4. Insert tool in top slot and clamp in position.
5. Adjust all stops for depth and mark bar for depth.
6. Make roughing passes.
7. Check roughing dimensions.
8. Measure depth and diameter of bore.
9. Finish bore to size.

DUTY A: OPERATING LATHES

21. TASK: Machine parts on faceplates

PERFORMANCE OBJECTIVE

Provided with part(s), drawing, lathe and measuring tools, align the part and machine part on the lathe faceplate. Part must be aligned to an accuracy of + or - 0.001".

TOOLS AND EQUIPMENT

Lathe
Faceplate
Clamps
Hardened bolts
Softhammer

Dial indicator
Chalk
Straps
Wrenches

PERFORMANCE GUIDE

1. Mount part on the faceplate.
2. Clamp, as necessary, using straps and hardened bolts.
3. Approximately line up part and snug clamps.
4. Turn lathe by hand and use chalk or toolholder end to sight part and check clearance.
5. Make adjustments, as needed, in part location.
6. Mount indicator and indicate part.
7. Adjust part location, tap lightly with soft hammer.
8. Snug clamps when part is properly located.
9. Balance faceplate.

DUTY A: OPERATING LATHES

22. TASK: Machine parts in collet chucks

PERFORMANCE OBJECTIVE

Provided with lathe, drawings, and part(s), choose collet, mount part and machine part. Meet tolerance of + or - 0.001".

TOOLS AND EQUIPMENT

Lathe
Collets
Measuring tools
Assorted tools

PERFORMANCE GUIDE

1. Assemble collet chuck on the lathe.
2. Mount work in collet (only cold rolled, ground stock, or turned stock, no hot rolled).
3. Set stops.
4. Set up tooling.
5. Establish reference zero.
6. Turn and face part to drawing.
7. Inspect part to dimension with measuring tools.

DUTY A: OPERATING LATHES

23. TASK: Machine parts in four jaw chuck

PERFORMANCE OBJECTIVE

Provided with part, drawings, lathe and measuring tools, align and machine part in four jaw chuck. Part must meet tolerance of + or - 0.001" alignment and same on dimensions or drawing specifications.

TOOLS AND EQUIPMENT

Lathe
Dial indicator
Wrenches
Measuring tools
Four jaw
Chalk
Precision

PERFORMANCE GUIDE

1. Place part in chuck, using concentric rings on chuck face to rough align part.
2. Center part by turning part and marking misalignment with chalk.
3. Work jaws opposite of each other, only just backing off pressure on side the direction part must move. Tighten opposite jaw and check alignment.
4. When close, mount indicator indicate part.
5. Be sure to correct for only ½ of the error in the readout on the indicator.
6. Once part is aligned, check jaws for snug.
7. Set up tooling and establish reference zero.
8. Take trial cuts and establish remaining cuts.
9. Check part to dimensions.
10. Determine and take finish cut.
11. Inspect part to drawing.

DUTY A: OPERATING LATHES

24. TASK: Machine parts between centers

PERFORMANCE OBJECTIVE

Provided with lathe, drawings, and part(s), place part between centers and turn to size. Part must meet tolerance of + or - 0.001" or drawing specs.

TOOLS AND EQUIPMENT

Lathe
Lathe dog
Precision measuring tools
Center drill
Tooling

PERFORMANCE GUIDE

1. Drill center holes in each end of part, either on drillpress or in a setup on the lathe.
2. Drill centerhold to 1/2 to 1/3 of 60 degree angle.
3. Place lathe dog on part with tail facing headstock of lathe.
4. Place live bearing center in tailstock.
5. Turn tailstock spindle out until center gently applies pressure in center hole.
6. Test pressure by turning part by hand, it should move freely and not feel any binding pressure.
7. Pick up reference zero on diameter with tool.
8. Dial in depth of cut on crossfeed.
9. Make trial cut, stopping 1" away from lathe dog.
10. Measure part and check pressure on center.
11. Calculate remaining cuts and proceed.
12. Measure part prior to finish cut.
13. Take finish cut.
14. Inspect part.

DUTY A: OPERATING LATHES

25. TASK: Align, face, and turn parts in three jaw chuck

PERFORMANCE OBJECTIVE

Provided with part(s), drawing, assorted measuring tools, align part in three jaw and face and turn part. Part must be aligned to tolerance of + or - 0.001". Part must be faced and turned to tolerance of + or - 0.001".

TOOLS AND EQUIPMENT

Lathe
Three jaw chuck
Wrenches
Part
Dial indicator
Precision measuring tools

PERFORMANCE GUIDE

1. Clean and attach chuck to lathe.
2. Chuck part in three jaw.
3. Install indicator and indicate part.
4. Lightly tap part to center with lead hammer or soft copper set.
5. Repeat steps, as necessary.

DUTY A: OPERATING LATHES

26. TASK: Maintain coolant system

PERFORMANCE OBJECTIVE

Provided with lathe, manuals, and needed tools, clean and maintain coolant system to manufacturer's specifications.

TOOLS AND EQUIPMENT

Lathe
Manuals
Cleaner
Sump pump
Fresh coolant
Floor sweep

PERFORMANCE GUIDE

1. Read manuals.
2. Check PH level.
3. Pump the coolant sump.
4. Apply floor sweep around machine to absorb spills and overflows.
5. Pour in cleaner and neutralizer.
6. Pump the sump out.
7. Mix coolant to manufacturer's specifications, and fill machine to full level.
8. Prime coolant pump, if necessary.
9. Clean up work area.

DUTY A: OPERATING LATHES

27. TASK: Set operating conditions

PERFORMANCE OBJECTIVE

Provided with part(s) to rough or finish cut, part drawing, and precision measuring instruments, set operating conditions on the lathe. Set conditions to hold tolerances of + 0.001" and - 0.000".

TOOLS AND EQUIPMENT

Lathe
Micrometer
Tool manufacturer's manual
Lathe tooling
Machinery's handbook

PERFORMANCE GUIDE

1. Identify part material.
2. Calculate speed, feed, and depth of cut of the lathe for specified operation.
3. Or use tooling manufacturer's manual to choose speeds and feeds for tooling and material.
4. Take into account the condition of the lathe and the horsepower of the motor before selecting high end speeds and feeds.
5. Consider rigidity of the part and setup.
6. Use roughing and finishing tools.
7. After cutting part, make adjustments to speeds and feeds, as needed.

DUTY A: OPERATING LATHES

28. TASK: Select proper turning tools

PERFORMANCE OBJECTIVE

Provided with part drawing, part sample, operations list, select proper tooling to perform operations.

TOOLS AND EQUIPMENT

Drawings
Assorted lathe tools
Manufacturer's manuals
Charts

PERFORMANCE GUIDE

1. Study drawing and determine operations needed.
2. Choose tooling to perform operations.
3. Check tooling for worn or broken cutting edges and parts.
4. Replace or change needed parts and proceed.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

1. TASK: Plan sequence of operations

PERFORMANCE OBJECTIVE

Provided with part drawings and blank operations forms, plan the sequence of boring operations.

TOOLS AND EQUIPMENT

Drawing
Forms
Pencil or computer

PERFORMANCE GUIDE

1. Review drawing and specifications.
2. Identify boring operations.
3. Determine most accurate and efficient sequence of operations.
4. Record sequence in proper order.
5. Review sequence for optimization of machine, tools, time.
6. Make any changes and submit final copy.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

2. TASK: Maintain boring machine

PERFORMANCE OBJECTIVE

Provided with boring machine, manuals, and proper lubricants, properly maintain machine to manufacturer's and department specifications.

TOOLS AND EQUIPMENT

Boring machine
Handtools
Lubricants
Rags
Various indicators

PERFORMANCE GUIDE

1. Read manual.
2. Clean machine properly.
3. Lubricate machine to manufacturer's instructions.
4. Inspect moving parts for wear.
5. Make any necessary adjustments to gibs, adjusting collars, etc.
6. Check readout tolerances with indicators.
7. Inspect spindle runout with indicators.
8. Report all inaccuracies.
9. Dispose of used lubricants and rags in a safe manner.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

3. TASK: Locate and solve machine problems

PERFORMANCE OBJECTIVE

Provided with machine tool (boring machine), trouble shoot and solve problems with the machine tool. Do not step over bounds of assigned skills and/or union job descriptions.

TOOLS AND EQUIPMENT

Boring machine
Manuals
Test equipment, as needed

PERFORMANCE GUIDE

1. Inspect machine for unfamiliar sounds
2. Check for low lubricant reservoirs.
3. Check for blown fuses, if allowable, with VOM.
4. Check for bearing wear and looseness.
5. Check for gib adjustment and lubrication.
6. Generally, check all machine adjustments.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

4. TASK: Recess internal surfaces

PERFORMANCE OBJECTIVE

Provided with part drawing, part(s), tools, and machine boring, bore and recess internal face. Part must meet specifications and hold tolerances of + or - 0.001".

TOOLS AND EQUIPMENT

Boring machine
Assorted tools
O.D. mic
Hone
Special ground tools, as needed

Boring bar assemblies
Depth mic
Hole gage
Cutting fluid

PERFORMANCE GUIDE

1. Set up boring machine and clamp part.
2. Drill and bore hole from reference zero.
3. Counterbore, as needed.
4. Assemble recess boring tool, as needed; hone tool, as needed.
5. Locate position of recess in hole, in diameter, or in a face of counterbore.
6. Set proper speeds and feeds, set stops, as needed.
7. Bore recess in part.
8. Inspect recess.
9. Deburr, clean, and inspect.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

5. TASK: Face internal surfaces

PERFORMANCE OBJECTIVE

Provided with part drawing, part(s), boring machine, and tooling, bore and backface or face internal surface(s). Part must meet drawing specifications and/or be within tolerance of + or - 0.005".

TOOLS AND EQUIPMENT

Boring machine
Boring bar
Depth micrometer
Outside micrometer
Clamps and tooling
Measuring instruments
Hole gage

PERFORMANCE GUIDE

1. Set up part in boring machine.
2. Locate reference zero.
3. Locate hole and drill, and bore hole to size.
4. Mount boring bar assembly for facing operations.
5. Set speeds and feeds.
6. Face counterbore face or backface hole to depth and diameter.
7. Check part to drawing specs.
8. Deburr and clean part.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

6. TASK: Bore internal surfaces

PERFORMANCE OBJECTIVE

Provided with part(s), part drawing, jig bore, and boring tools, bore hole in part. Hole must meet tolerance of + or - 0.001" on diameter, and + or - 0.0005" location, or meet drawing specifications.

TOOLS AND EQUIPMENT

Jig bore
Edge finder or indicator
Centerdrill
Assorted tools
Boring tools
Drill
Cutting fluid

PERFORMANCE GUIDE

1. Clamp and secure part.
2. Locate reference zero, locate hole from reference zero.
3. Centerdrill and drill hole.
4. Inspect boring tool for cutting edge for conformity.
5. Mount boring tool in tool holder.
6. Select speeds and feeds.
7. Select or set depth stops.
8. Set depth of cut to bore after picking up edge of hole.
9. Apply cutting fluid, as needed.
10. Trial cut and measure.
11. Finish bore part.
12. Measure bored hole to tolerances.
13. Clean, deburr, and inspect.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

7. TASK: Tap holes on machine

PERFORMANCE OBJECTIVE

Provided with part(s), tapping equipment, charts and handbooks, drawing, tap a hole in the part with a tapping attachment. Hole will meet specifications and fit gages.

TOOLS AND EQUIPMENT

Drillpress
Tapping attachment
Drills
Go/no go gages
Cutting fluid

Boring machine
Manuals
Taps
Centerdrill

PERFORMANCE GUIDE

1. Mount part.
2. Select tap drill.
3. Select tap.
4. Centerdrill and drill part.
5. Mount and set up tapping attachment.
6. Mount tap in collet.
7. Set speeds.
8. Set necessary stops.
9. Tap hole to specs.
10. Apply cutting fluid during process.
11. Clean hole and tap.
12. Inspect and check hole with gage.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

8. TASK: Establish zero reference

PERFORMANCE OBJECTIVE

Provided with part(s), drawings, boring or drilling machine, locate zero reference point on part for all holes to be located from. Must be within 0.0001".

TOOLS AND EQUIPMENT

Drilling or boring machine
Edge finder or dial indicator
Clamps
Tools

PERFORMANCE GUIDE

1. Determine zero reference from drawing.
2. Mount part in machine and secure.
3. Mount edge finder in chuck or collet.
4. Set speeds for edge finder.
5. Turn on machine.
6. Touch edge finder to make it run nonconcentric.
7. Dial over to part until edge finder touches part.
8. Dial over until edge finder runs true and then move off concentric.
9. Zero dials.
10. Bring spindle up.
11. Dial over ½ diameter of edge finder end.
12. Zero dial.
13. Repeat steps for other edge.
14. If using dial indicator, use similar technique with the aid of edge sweep device.
15. Mount dial indicator in chuck or collet.

DUTY B: PERFORMING HOLE-FORMING OPERATIONS

9. TASK: Set Operating Conditions

PERFORMANCE OBJECTIVE

Provided with a part in which to produce a required hole, and hole forming manual/guidelines set the operating conditions (feed, speed, depth of cut (doc)) appropriate to complete the assigned task. To include holding the workpiece and select and apply tool.

TOOLS AND EQUIPMENT

Hole forming machine
Required cutting tools
Hole forming manual/guidelines
Part print
Measuring/inspection tools

PERFORMANCE GUIDE

1. Determine needed operating conditions.
2. Determine cutter and part material.
3. Set the operating conditions (feed, speed, depth of cut (DOC)), and cutter rotation.
4. Mount part appropriately to allow machining the required hole.
5. Select and properly apply correct cutting tool and fluids.
6. Check entire set up for safe operation.

DUTY C: PERFORMING DRILLING OPERATIONS

1. TASK: Countersink parts

PERFORMANCE OBJECTIVE

Provided with part, part drawing, countersink a predrilled hole using the drill press. The countersunk hole must meet drawing specs, and/or be within a tolerance of + or - 0.005".

TOOLS AND EQUIPMENT

Drill press
Cutting oil
Semi-precision measuring tools
Clamping devices
Countersink

PERFORMANCE GUIDE

1. Secure part in drill press.
2. Locate hole, if reset up.
3. Secure countersink in chuck.
4. Select speeds.
5. Align countersink, if not already completed.
6. Countersink to specifications.
7. Apply cutting oil.
8. Set stop for depth.
9. Hold cutter in place at depth to obtain full depth and finish.
10. Verify dimensions to width of countersink across top or face.

DUTY C: PERFORMING DRILLING OPERATIONS

2. TASK: Center drill and drill holes

PERFORMANCE OBJECTIVE

Provided with drawings, part(s), drills, clamps, first center drill hole, second drill a through hole.

TOOLS AND EQUIPMENT

Center drill
Drills
Clamps
Lubricant
Charts

PERFORMANCE GUIDE

1. Choose center drill for job application.
2. Choose drill for application.
3. Align and clamp parts.
4. Select speed and feeds.
5. Insert center drill into tool holder.
6. Drill to 1/3 to 1/2 up the 60 degree angle of the center drill.
7. Use light pressure on tip of center drill and apply lubricant.
8. Remove.
9. Insert drill into holder.
10. Select or change speed and feed.
11. Drill hole at center drill using light feed pressure to start drilling, apply cutting fluid, as needed.
12. Use peck drill strokes for deep holes.
13. Clear chips for deep holes.
14. Ease off feed pressure as drill breaks through the bottom of hole.
15. Remove drill and inspect hole.

DUTY C: PERFORMING DRILLING OPERATIONS

3. TASK: Align workpieces

PERFORMANCE OBJECTIVE

Provided with part(s), part drawing, and drilling equipment, align and mount (clamp) the part(s). The part shall be aligned to maintain a tolerance of + or - 1/64" to 0.005" or drawing specifications.

TOOLS AND EQUIPMENT

Drill press
Straps
Assorted tools
Square
Vise
Clamps
Parallels
Wiggler
Edge finder

PERFORMANCE GUIDE

1. Study drawings and part(s).
2. Determine best clamping methods.
3. Lightly clamp part.
4. Move part close to alignment by eye.
5. Use either wiggler or edge finder depending on accuracy required and available method of locating part; i.e., table with cranks and micrometer dials.
6. Set speed for use of either locator, two to three times drill speed, or about 800 to 1,000 rpm.
7. Gently move part to position to achieve desired results for locator type.
8. Clamp part.

DUTY C: PERFORMING DRILLING OPERATIONS

4. TASK: Change drills and holders

PERFORMANCE OBJECTIVE

Provided with operations list, tools, parts drill and holder, and/or chucks, change drills and holders. Must be performed in a safe manner, with proper tools and order of operation.

TOOLS AND EQUIPMENT

Chuck wrench
Sleeves
Assorted tools
Drill drifts
Drills
Quick change holders & chuck
Rags

PERFORMANCE GUIDE

1. Determine type of holder or driver needed.
2. Choose drills and holder.
3. Clean holders and drill shanks.
4. Look and remove burrs that might not allow drill or boring bar, etc., to seat properly.
5. Determine if sleeves are required.
6. Assemble drills into sleeves or chucks.
7. Check runout prior to drilling operation.
8. Remove drill from holder, and clean both.
9. Properly return to storage.

DUTY C: PERFORMING DRILLING OPERATIONS

5. TASK: Select drills

PERFORMANCE OBJECTIVE

Provided with part drawings, material, and operations list, select proper drill(s) for the job. Drills must be of correct types and sizes for job specs.

TOOLS AND EQUIPMENT

Drill sets
Material
Charts
Drill gauge
Dial caliper

PERFORMANCE GUIDE

1. Read job specifications.
2. Read operations list.
3. Determine and choose the correct drills for the operations.
4. Determine if the drills need sharpening.

DUTY C: PERFORMING DRILLING OPERATIONS

6. TASK: Set Operating Conditions

PERFORMANCE OBJECTIVE

Provided with part drawings, plan the sequence of drilling operations.

TOOLS AND EQUIPMENT

Drawings
Charts
Manuals and handbooks

PERFORMANCE GUIDE

1. Study drawings and specs.
2. Determine tooling.
3. Determine most efficient sequence of operations.
4. Record sequence on correct forms.
5. Review for errors or time saving changes.

DUTY C: PERFORMING DRILLING OPERATIONS

7. TASK: Maintain drilling machine

PERFORMANCE OBJECTIVE

Provided with drillpress and service manuals, clean and lubricate to manual specifications. Clean and refill coolant sumps to coolant manufacturer's specs.

TOOLS AND EQUIPMENT

Drilling machine
Grease gun
Cleaner
Rags
Lube oil
Sump pump
Fresh coolant
Floor sweep compound

PERFORMANCE GUIDE

1. Read manual(s) for lube points.
2. Choose lube or grease specified.
3. Lube specified points.
4. Drain or pump coolant sump.
5. Rinse with cleaner.
6. Fill with coolant to mix ratio specified and to sump fill level.
7. Re-prime coolant pump, as needed.
8. Follow procedures for disposal of coolants.

DUTY C: PERFORMING DRILLING OPERATIONS

8. TASK: Sharpen drills

PERFORMANCE OBJECTIVE

Provided with grinder, drill gage, and/or grinding fixture, part, and references, sharpen drill. Drill must fit gage, and drill a hole to tolerance of + or - 0.005".

TOOLS AND EQUIPMENT

Grinder
Manuals
Drill point gage
Drill grinding attachments
Hole gage
Drillpress
Charts
Micrometer

PERFORMANCE GUIDE

1. Dress and true grinding wheel.
2. Check angle needed on drill point as per material specifications.
3. Grind lip clearance, length, and angle to specs.
4. Check point angle.
5. Mount in drill grinding attachment, if available.
6. Repeat steps as necessary to set up and grind drill.
7. Grind alternately each lip to achieve concentricity of grind.
8. Mount and drill part to check drilling capabilities.
9. Measure drilled hole.

DUTY C: PERFORMING DRILLING OPERATIONS

9. TASK: Drill holes at angle

PERFORMANCE OBJECTIVE

Provided with part(s), drawings, tooling, and drillpress, drill a hole at an angle in part. Hole must meet tolerance of + or - 30 minutes angularity, and position of + or - 0.005" or to drawing specifications.

TOOLS AND EQUIPMENT

Angle plate
Clamps
Tools
Measuring tools
Centerdrills
Vee block
Part(s)
Drills
Cutting fluid
End mill

PERFORMANCE GUIDE

1. Determine best part holding method.
2. Clamp and position part.
3. Use end mill to machine flat to drill or centerdrill to a depth that will allow drill to hold position.
4. Mount and locate drill over position.
5. Drill hole carefully to resist drill walking out of part at start.
6. Use cutting fluid, as needed.
7. Check tolerances and dimensions.

DUTY C: PERFORMING DRILLING OPERATIONS

10. TASK: Burnish holes

PERFORMANCE OBJECTIVE

Provided with part(s), part drawings, drillpress, or boring machine, burnish holes to specifications.

TOOLS AND EQUIPMENT

Burnishing tool(s)
Clamping devices
Drills
Tools
Micrometers
Cutting fluid
Drillpress or boring machine
Vises
Centerdrill
Hole gages
Verniers

PERFORMANCE GUIDE

1. Study drawing for hole location and dimensions.
2. Locate and clamp part(s).
3. Drill hole, as needed.
4. Ream or bore hole to tolerance.
5. Select burnishing tool.
6. Select speeds and feeds.
7. Mount tooling.
8. Burnish hole, apply cutting fluid, as needed, check dimensions, and finish.
9. Deburr, clean, and inspect.

DUTY C: PERFORMING DRILLING OPERATIONS

11. TASK: Ream holes to size

PERFORMANCE OBJECTIVE

Provided with part drawing, part(s), drillpress, and accessories, ream hole to specifications and tolerances of + 0.0015" or - 0.0000".

TOOLS AND EQUIPMENT

Drillpress
Center drill
Reamers (fixed and adjustable)
Hole gage
Clamping devices or vises
Drills
Vernier micrometer
Cutting fluid

PERFORMANCE GUIDE

1. Identify material and cutting speeds for reaming.
2. Drill hole as is necessary.
3. Set speeds for reaming, see handbook.
4. Select reamer, check size.
5. Locate and secure part.
6. Check rigidity of setup.
7. Ream hole, feed in, and feed out.
8. Apply cutting fluid, as needed.
9. Measure hole.
10. Deburr, clean, and inspect.

DUTY C: PERFORMING DRILLING OPERATIONS

12. TASK: Drill holes with special drills

PERFORMANCE OBJECTIVE

Provided with part(s), drawings, special drill (i.e., flat bottom, tapered, spade bits, carbide drills), drill holes to specifications.

TOOLS AND EQUIPMENT

Drillpress
Tools
Drilling fluid
Vernier caliper
Hole gages
Assorted drills
Clamping devices
Measuring devices
Depth mic

PERFORMANCE GUIDE

1. Study drawing.
2. Select drill(s).
3. Mount parts.
4. Align part to drill location.
5. Set speeds for special drill(s).
6. Set depth stops, as necessary.
7. Set feeds, as necessary.
8. Drill hole(s) to specifications.
9. Use drill strokes, as needed.
10. Clear chips.
11. Check holes for depth and tolerances.

DUTY C: PERFORMING DRILLING OPERATIONS

13. TASK: Drill holes to specified depths

PERFORMANCE OBJECTIVE

Provided with part(s), part drawing, drill and clamping devices, drill a blind home and a deep hole. Holes must be straight and to specified tolerances on part drawing.

TOOLS AND EQUIPMENT

Part
Drills of assorted sizes
Clamps
Tools
Drillpress

PERFORMANCE GUIDE

1. Study drawing for sizes and lengths of drills.
2. Clamp and secure part.
3. Locate and position part.
4. Mount drill in drillpress.
5. Set depth stops.
6. Drill hole(s).
7. Use peck drill movements.
8. Use cutting or drilling fluid.
9. Clear chips.
10. Check depths and hole size.

DUTY C: PERFORMING DRILLING OPERATIONS

14. TASK: Spotface parts

PERFORMANCE OBJECTIVE

Provided with part(s), part drawing, and drilling tools, spotface hole in part. Meet tolerances of + or - 0.005" on decimals or + or - 1/64" on fractions and/or drawing callouts.

TOOLS AND EQUIPMENT

Drillpress
Spotfacing tool
Steel rule
Clamps or vise
Measuring tools
Machinery's handbook

PERFORMANCE GUIDE

1. Identify and select part holding.
2. Secure part.
3. Choose spotface and pilot.
4. Mount tooling in drill.
5. Select speeds to handbook.
6. Set stop depth.
7. Align part.
8. Spotface part.
9. Use cutting fluid, as needed.
10. Dwell at stop depth.
11. Check tolerances.

DUTY C: PERFORMING DRILLING OPERATIONS

15. TASK: Counterbore parts

PERFORMANCE OBJECTIVE

Provided with part(s), part drawing, counterbore the part on the drillpress. The tolerance on dimensions is + or - 0.001" on decimal dimensions and 1/64" on all fractional dimensions, unless called out otherwise on drawing specifications.

TOOLS AND EQUIPMENT

Drillpress
Clamps or vise
Centerpunch
Hammer
Cutting fluid
Depth micrometer
Counterbore
Part with or without predrilled hole
Drills
Measuring instruments

PERFORMANCE GUIDE

1. If needed, centerpunch hole after hole layout.
2. Clamp or hold part in vise.
3. Locate hole unless operation done in sequence after drilling.
4. Drill part.
5. Select counterbore and pilot, set speed, set depth stop.
6. Counterbore to drawing.
7. Apply cutting fluid, as needed.
8. Apply steady, even feed pressure, if hand fed, idle at bottom of hole to achieve depth.
9. Check depth and diameter of counterbored hole.

DUTY C: PERFORMING DRILLING OPERATIONS

16. TASK: Set operating conditions

PERFORMANCE OBJECTIVE

Provided with a correctly sharpened twist drill, part print, and material set up the tool, workpiece and operting conditions to produce a drilled hole to specifications.

TOOLS AND EQUIPMENT

Twist drill
Drilling machine
Part print
Material
Handbook
Work holding and tool application guidelines

PERFORMANCE GUIDE

1. Determine needed operations to produce drilled hole.
2. Determine cutter material and part material.
3. Mount workpiece to be drilled.
4. Apply cutting tool and fluids correctly.
5. Set the operating conditions (feed, speed, (doc)) and cutter rotation.
6. Check entire set up for safe operations.

DUTY D: PERFORMING CUT-OFF OPERATIONS

1. TASK: Plan sequence of sawing operations

PERFORMANCE OBJECTIVE

Provided with part(s) and drawings, plan out rough and finish saw operations prior to sawing parts.

TOOLS AND EQUIPMENT

Drawings
Part

PERFORMANCE GUIDE

1. Study drawings for sequence of operations.
2. Study specifications for tolerance and finish allowances.
3. Plan out operations and steps.

DUTY D: PERFORMING CUT-OFF OPERATIONS

2. TASK: Clean, lubricate saw, and maintain saw coolant system

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PERFORMANCE OBJECTIVE

Demonstrate in use of the saws, proper saw cleaning, saw lubrication and maintenance of the coolant system. Include proper adjustment of guide clearances of 0.001" to 0.002".

TOOLS AND EQUIPMENT

Bandsaw
Operator's manual
Tools
Rags
New guide inserts

Brushes
Cleaner
Lubricant
Feeler gage

PERFORMANCE GUIDE

1. Clean away all chips with the brush.
2. Clean oil and dirt with rags.
3. Lubricate saw.
4. Inspect all guides, tension, alignment of blade.
5. Verify adjustments.
6. Drain sump.
7. Circulate cleaner through coolant system, flush system.
8. Mix and/or add fresh coolant to levels.
9. Check pumping of coolant system.

DUTY D: PERFORMING CUT-OFF OPERATIONS

3. TASK: File parts on bandsaw

PERFORMANCE OBJECTIVE

Provided with drawings, part(s), bandsaw, continuous file, file rough saw cut to line within 0.005".

TOOLS AND EQUIPMENT

Continuous file
Bandsaw
Clamping device, as needed
Brush

PERFORMANCE GUIDE

1. Check drawing and layout lines on part.
2. Select continuous file.
3. Select speeds and feeds from machinery's handbook.
4. Install file after removing blade.
5. Set tension per operators manual.
6. File part staying away from part 0.005" to 0.008" or closer.
7. Inspect part for continuity or profile and finish.

DUTY D: PERFORMING CUT-OFF OPERATIONS

4. TASK: Saw miscellaneous contours

PERFORMANCE OBJECTIVE

Provided with parts or exercises, drawings, saw, needed holding devices, saw angles, slots, and miters. Sawed parts must be within 1/32" of lines.

TOOLS AND EQUIPMENT

Bandsaw
Part(s)
Holding devices
Measuring tools

PERFORMANCE GUIDE

1. Inspect drawings for information.
2. Choose blade.
3. Select speeds and feeds.
4. Set table angles or part angles.
5. Select holding device.
6. Select entering cut location.
7. Cut part.
8. Inspect part to specifications.

DUTY D: PERFORMING CUT-OFF OPERATIONS

5. TASK: Saw contours--Internal

PERFORMANCE OBJECTIVE

Provided with part drawing, part, bandsaw, saw internal contour or part. Cut must be within 1/32" of lines.

TOOLS AND EQUIPMENT

Saw
Blade stock
Drill press
Center punch
Snips or blade cutter
Blade welder
Part
Drills
Hammer

PERFORMANCE GUIDE

1. Check part for contours too sharp to cut.
2. Check minimum radius blade will cut.
3. Layout and center punch hole for inserting blade.
4. Drill hole(s).
5. Remove blade from saw.
6. Cut saw blade in half or make up new blade for application.
7. Insert blade through hole in part.
8. Weld blade per blade welding practice.
9. Mount blade on saw and set blade speed.
10. Saw part internally not forcing cuts.
11. When finished, cut blade at original weld.
12. Remove blade from part, reweld blade.
13. Replace blade and adjust.

DUTY D: PERFORMING CUT-OFF OPERATIONS

6. TASK: Saw contours--Exterior

PERFORMANCE OBJECTIVE

Provided with part, drawing, and saw, saw a contour on the outside of the part. Must be within 1/32" of layout, and/or meet specs.

TOOLS AND EQUIPMENT

Bandsaw
Part
Drawing
Lubricant, as needed

PERFORMANCE GUIDE

1. Check part for curves too sharp to contour.
2. Check allowable radius for blade.
3. Choose start point, set blade speed.
4. Cut part within 1/32".
5. Inspect part.
6. Deburr, clean, and inspect.

DUTY D: PERFORMING CUT-OFF OPERATIONS

7. TASK: Saw to scribed line--Straight

PERFORMANCE OBJECTIVE

Provided with print, work holding device, as needed, saw part to scribed lines and job specs. Part must be within 1/32" of lines.

TOOLS AND EQUIPMENT

Bandsaw
Part
Saw blades
Work holding device

PERFORMANCE GUIDE

1. Inspect lines for clarity.
2. Set up guide, as needed.
3. Check and choose correct blade.
4. Set speeds.
5. Make adjustments in holding device.
6. Saw part to lines.
7. Keep constant check on saw direction and cut.
8. Nearing end of cut, ease off the feed pressure.

DUTY D: PERFORMING CUT-OFF OPERATIONS

8. TASK: Select speeds and feeds for sawing

PERFORMANCE OBJECTIVE

Provided with stock, part drawing, references, and appropriate saw, select and set speed and feed for sawing operation called out. Set speeds from Machinery's handbook.

TOOLS AND EQUIPMENT

Bandsaw
Hacksaw
Handbook
Operator's manual

PERFORMANCE GUIDE

1. Study drawing.
2. Determine material and speeds.
3. Choose proper saw.
4. Choose proper blade for material.
5. Determine and set machine speeds.
6. Determine feed, if available.

DUTY D: PERFORMING CUT-OFF OPERATIONS

9. TASK: Cut and weld bandsaw blades

PERFORMANCE OBJECTIVE

Furnished with bandsaw blade(s), specifications, and bandsaw welder, cut and weld blade. Blade must be straight, without flash and annealed, and ground to thickness gage.

TOOLS AND EQUIPMENT

Bandsaw blade (stock)
Manuals
Bandsaw welder
Grinder
Tim snips

PERFORMANCE GUIDE

1. Cut blade stock.
2. Grind blade ends square, and reverse or turn over one to create a matching grind.
3. Insert blades in welder jaws.
4. Point teeth in proper direction per manual.
5. Butt ends and clamp.
6. Check to see blade is centered and properly aligned against backstop in clamp.
7. Set blade width and/or pressure and weld.
8. Release pressure on clamp.
9. Clamp and anneal to dull red, back off color slowly.
10. Grind flash to gage thickness.
11. Clamp blade in welder.
12. Anneal to blue color slowly.
13. Remove and mount blade in saw, if necessary.

DUTY D: PERFORMING CUT-OFF OPERATIONS

10. TASK: Replace saw blades

PERFORMANCE OBJECTIVE

Provided with power saw and blade, handtools, charts, and references, remove and replace the blade. The blade must be aligned to manufacturers specifications. Test cut the saw.

TOOLS AND EQUIPMENT

Bandsaw
Power hacksaw
Saw blades
Operator's manuals

PERFORMANCE GUIDE

Metal Bandsaw

1. Select saw blades.
2. Shut off electrical power.
3. Release blade tension.
4. Remove blade carefully.
5. Loop or curl up blade for storage.
6. Check guides for wear and adjust or replace, if necessary.
7. Unwind new blade or makeup new blade.
8. Install new blade properly.
9. Apply tension as per machine instructions and test tension, inspect guide clearance.

Power Hacksaw

1. Select saw blade.
2. Shut off electrical power.
3. Release tension on blade.
4. Remove and store old blade.
5. Adjust for length of new blade.
6. Mount or place new blade into clamps.
7. Inspect direction teeth are pointed.
8. Tighten blade in frame to manufacturer's specifications.

DUTY E: PERFORMING LAYOUTS

1. TASK: Transfer layouts from models

PERFORMANCE OBJECTIVE

Provided a real part, material, and tools, transfer real part to layout on material, hold part dimensions.

TOOLS AND EQUIPMENT

Assorted layout and measuring tools
Real part
Material

PERFORMANCE GUIDE

1. Study part and material configuration.
2. Measure part.
3. Make shop sketch.
4. Transfer profile and dimensions to material.
5. Check work, and verify layout.

DUTY E: PERFORMING LAYOUTS

2. TASK: Layout reference points

PERFORMANCE OBJECTIVE

Provided with part drawings, raw stock, layout reference points, and prick punch.

TOOLS AND EQUIPMENT

Layout fluid
Height gage
Hammer
Surface gage
Squares
Punches
Dividers
Surface plate

PERFORMANCE GUIDE

1. Clean material, deburr, and place on paper towel.
2. Apply layout fluid, where needed.
3. Choose layout tool per application.
4. Layout points.
5. Prick punch lightly.
6. Check with magnifying glass.
7. Move punch marks accordingly.
8. Re-check locations.

DUTY E: PERFORMING LAYOUTS

3. TASK: Layout angles, arcs, and locations from reference points

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PERFORMANCE OBJECTIVE

Provided with part drawing, material, and layout tools, layout part to drawing tolerances.

TOOLS AND EQUIPMENT

Layout tools
Material
Layout fluid

PERFORMANCE GUIDE

1. Study print.
2. Use calculations made previously.
3. Mark start points.
4. Lay out angle with bevel protractors.
5. Scribe arcs from reference points, with dividers.
6. Punch around arcs and holes for reference.
7. Check layout to drawing.

DUTY E: PERFORMING LAYOUTS

4. TASK: Calculate reference points

PERFORMANCE OBJECTIVE

Provided with part drawing, material, calculate the reference points for points, angle, arcs. Calculations must meet specifications.

TOOLS AND EQUIPMENT

Calculator

PERFORMANCE GUIDE

1. Study drawings.
2. Calculate reference points.
3. Circle on drawing in color or record on another document.

DUTY E: PERFORMING LAYOUTS

5. TASK: Play layout operations

PERFORMANCE OBJECTIVE

Provided with drawing and specifications, plan the layout process of operations to accurately lay out part.

TOOLS AND EQUIPMENT

Drawing
Material

PERFORMANCE GUIDE

1. Study information available.
2. Determine sequence of layout operations.
3. Determine at what part of processing layout must be done.
4. Record procedures.

DUTY E: PERFORMING LAYOUTS

6. TASK: Compute layout dimensions

PERFORMANCE OBJECTIVE

Provided with part drawings, compute and record layout dimensions.

TOOLS AND EQUIPMENT

Calculator
Drawings
Materials

PERFORMANCE GUIDE

1. Study drawings.
2. Identify critical layout dimensions.
3. Calculate allowances for rough dimensions.
4. Record data.

DUTY E: PERFORMING LAYOUTS

7. TASK: Analyze layout specifications

PERFORMANCE OBJECTIVE

Provided with part drawing, material, analyze, and determine order and method of layout procedures.

TOOLS AND EQUIPMENT

Material
Specifications

PERFORMANCE GUIDE

1. Study drawing for details.
2. Determine method of layout.
3. Choose layout procedures.

DUTY F: PERFORMING PRECISION MEASUREMENT

1. TASK: Inspect assemblies

PERFORMANCE OBJECTIVE

Provided with assemblies, part drawings, inspect to assure proper assembly and operation.

TOOLS AND EQUIPMENT

Assembly
Handtools
Measuring tools
Light
Mirrors

PERFORMANCE GUIDE

1. Set up inspection routine.
2. Determine areas to inspect.
3. Inspect for proper installation, clearances, operation.

DUTY F: PERFORMING PRECISION MEASUREMENT

2. TASK: Verify clearances

PERFORMANCE OBJECTIVE

Provided with parts, assemblies, or dies, use measuring tool to verify proper clearance to drawing specifications.

PERFORMANCE GUIDE

1. Determine clearances from drawing.
2. Choose method of measuring or checking clearances.
3. Check clearance.
4. Record values.
5. Compare to drawing values.
6. Make recommendations.

DUTY F: PERFORMING PRECISION MEASUREMENT

3. TASK: Verify alignments

PERFORMANCE OBJECTIVE

Provided with assemblies, part specifications, check assembly for proper alignments of parts and mechanisms.

TOOLS AND EQUIPMENT

Assembly
Dial indicators
Clamps
Handtools

PERFORMANCE GUIDE

1. Determine part or section to check.
2. Check drawing standards.
3. Set up indicators.
4. Check alignments.
5. Make recommendations.

DUTY F: PERFORMING PRECISION MEASUREMENT

4. TASK: Monitor reports

PERFORMANCE OBJECTIVE

During production process, monitor reports of part discrepancies or rejects. Report on appropriate forms and in chain-of-command.

TOOLS AND EQUIPMENT

Reports
Operating procedures

PERFORMANCE GUIDE

1. Study reporting format.
2. Follow production process.
3. Check for part discrepancy.
4. Record data.
5. Record data and reasons for rejection or discrepancy.

DUTY F: PERFORMING PRECISION MEASUREMENT

5. TASK: Inspect parts according to quality control

PERFORMANCE OBJECTIVE

Provided with parts, quality control inspection area, inspect parts to standards and procedures for area. Parts shall meet standards or drawing specifications.

TOOLS AND EQUIPMENT

Operating procedures
Inspection equipment
Parts

PERFORMANCE GUIDE

1. Study operating procedures and inspection techniques.
2. Study part drawing for specifications and tolerances.
3. Record data on appropriate forms.
4. Inspect parts by lot or total part inspection techniques.
5. Record findings on forms.
6. Label rejects and deviations.
7. Label re-works.

DUTY F: PERFORMING PRECISION MEASUREMENT

6. TASK: Perform first piece inspection

PERFORMANCE OBJECTIVE

Provided with part drawing, first part of run, perform inspection to tolerances on part drawing.

TOOLS AND EQUIPMENT

Part
Precision measuring tools
Part inspection standards

PERFORMANCE GUIDE

1. Set up inspection area or routine.
2. Choose measuring instrument.
3. Inspect for dimensions.
4. Inspect for concentricity.
5. Inspect for parallelism.
6. Inspect for relation to reference points.
7. Check for angularity, if needed.
8. Check for surface finish and integrity.

DUTY F: PERFORMING PRECISION MEASUREMENT

7. TASK: Calibrate precision measuring tools

PERFORMANCE OBJECTIVE

Furnished with precision measuring instruments, standards, clean, lubricate, and calibrate instruments.

TOOLS AND EQUIPMENT

Precision instruments (micrometers, vernier calipers, bevel protractors, dial indicators, vernier height gages, and depth gages)

Cleaner

Lubricant rags

Standards

PERFORMANCE GUIDE

1. Remove all grease and dirt.
2. Apply cleaning solution and dry.
3. Remove any rust.
4. Lubricate all bright surfaces and moving parts.
5. Calibrate to standards.
6. Store instruments properly.

DUTY F: PERFORMING PRECISION MEASUREMENT

8. TASK: Calibrate micrometers

PERFORMANCE OBJECTIVE

Provided with micrometers and adjustment tool, gage blocks, adjust micrometer to standards.

TOOLS AND EQUIPMENT

Micrometer
Adjusting wrench
Gage block
Cleaner
Lubricant

PERFORMANCE GUIDE

1. Clean.
2. Check for accuracy against gage block.
3. Make necessary adjustment gently and carefully.
4. Check for accuracy.
5. Lubricate, if necessary.
6. Repeat steps, as necessary, to meet standards.

DUTY F: PERFORMING PRECISION MEASUREMENT

9. TASK: Measure gears

PERFORMANCE OBJECTIVE

Provided with part drawing, gear part, and gear tooth vernier, dowel pins, vernier caliper, micrometer, measure gear to tolerances and specifications.

TOOLS AND EQUIPMENT

Micrometer
Gear tooth vernier
Vernier caliper
Dowel pins

PERFORMANCE GUIDE

1. Clean part.
2. Determine method of measurement; i.e., tooth dimensions with gear tooth vernier, across three teeth with vernier caliper, across calculated pins across the pitch diameter with a micrometer.
3. Make calculations as per method chosen.
4. Compare reading to specifications.
5. Make adjustments in process.

DUTY F: PERFORMING PRECISION MEASUREMENT

10. TASK: Measure keyseat

PERFORMANCE OBJECTIVE

Provided with part drawing, parts with keyseat, micrometers, adjustable parallels, and/or dowel pins, measure keyseat to specifications.

TOOLS AND EQUIPMENT

Micrometers
Adjustable parallels
Dial caliper
Dowel pins
Charts

PERFORMANCE GUIDE

1. Deburr parts and clean.
2. Choose measurement device or method.
3. Check drawing and keyseat chart specifications.
4. Measure width with adjustable parallel and micrometer.
5. Measure depth from top down with depth mic or from bottom of keyseat to bottom of shaft with micrometer or dial caliper, per drawing.

DUTY F: PERFORMING PRECISION MEASUREMENT

11. TASK: Measure tapers

PERFORMANCE OBJECTIVE

Provided with tapered parts, micrometer or dial indicator, or micrometer and thread wires, measure taper. Measurement must meet specifications or tolerance of + or - 0.001".

TOOLS AND EQUIPMENT

Parts
Micrometers
Dial indicator
Thread wires

PERFORMANCE GUIDE

1. Deburr and clean parts.
2. Choose method of measurement to meet application.
3. Measure taper with taper micrometer, or one other method.
4. If using alternate method, measure small and large end or compare taper per inch with calculations from charts for tapers or drawing specifications.
5. Determine errors or adjustments of process.

DUTY F: PERFORMING PRECISION MEASUREMENT

12. TASK: Measure threads

PERFORMANCE OBJECTIVE

Provided with a threaded part, part drawing, and precision measuring instruments, measure the part. The threads must be in tolerance of + or - 0.001" or meet drawing specifications.

TOOLS AND EQUIPMENT

Thread measurement wires
Gage blocks
Vernier micrometer
Machinery handbook

PERFORMANCE GUIDE

1. Deburr and clean part.
2. Select micrometer and check adjustment.
3. Select thread wires as per handbook or wire charts with set.
4. Measure workpiece with wires and micrometer.
5. Verify part dimensions to part drawing specifications and tolerances.
6. Use gages to specifications.

DUTY F: PERFORMING PRECISION MEASUREMENT

13. TASK: Measure angles, arcs, and locations from reference point

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PERFORMANCE OBJECTIVE

Provided with part drawing, parts and bevel protractor, measure angles and arcs from reference point. All measurements must be within tolerance of + or - 30 seconds or meet drawing specifications.

TOOLS AND EQUIPMENT

Parts
Bevel protractor
Angle plates
Dividers
Clamps

PERFORMANCE GUIDE

1. Study drawing for reference points and angles.
2. Mount part on angle plate and place on surface plate.
3. Loosen lock screws on bevel protractor.
4. Adjust protractor to angle.
5. Place on part and compare angle.
6. Determine if error exists.
7. Inspect error adjustment.
8. Adjust protractor to part angle or reference and read difference.

DUTY F: PERFORMING PRECISION MEASUREMENT

14. TASK: Measure angles using sine bar

PERFORMANCE OBJECTIVE

Provided with part drawing, parts, and precision measuring instruments, align part at an angle. The part must be aligned within + or - five minutes of the specifications.

TOOLS AND EQUIPMENT

Machinist's handbook
Sine bar
Angle plate
Dial indicator
Gage blocks
Surface plate
Clamps
Part

PERFORMANCE GUIDE

1. Place angle plate on surface plate.
2. Clean surface plate, if necessary.
3. Check and remove burrs on work surfaces.
4. Determine angle requirements.
5. Select sine bar and gage blocks.
6. Ring gage blocks for correct setting as per handbook.
7. Place sine bar on gage blocks.
8. Mount indicator on stand.
9. Clamp part to sine bar.
10. Traverse part with indicator and check to specifications.

DUTY F: PERFORMING PRECISION MEASUREMENT

15. TASK: Measure parts with height gage

PERFORMANCE OBJECTIVE

Provided with parts, drawings, and precision measuring instruments, measure parts. Tolerance is + or - 0.001".

TOOLS AND EQUIPMENT

Vernier height gage
Attachments
Surface plate
Files
Cleaner

PERFORMANCE GUIDE

1. Deburr and clean the parts.
2. Clean surface plate.
3. Set part on surface plate.
4. Set height gage on plate.
5. Assemble necessary parts to height gage, offset scribe, indicator, etc.
6. Check zero reference setting of gage.
7. Slide vernier scale so scribe or indicator is just above the part.
8. Lock vernier scale.
9. Fine adjust until scriber or indicator touches part.
10. Lock fine adjustment screw.
11. Use magnifying glass as needed to read vernier scale.

DUTY F: PERFORMING PRECISION MEASUREMENT

16. TASK: Measure parts using optical comparators

PERFORMANCE OBJECTIVE

Provided with part, template or comparator charts, and drawings, check the part on the comparator. Part must fit the template or chart to within + or - 0.001" and + or - 1 degree, or meet specifications.

TOOLS AND EQUIPMENT

Part
Dial indicator
Other assorted parts as comparator needs
Optical comparator
Template or charts

PERFORMANCE GUIDE

1. Mount necessary attachments.
2. Mount magnification lens.
3. Turn on comparator.
4. Mount workpiece either on centers or in vee on riser block.
5. Align part with dial indicator.
6. Mount necessary template or chart and focus.
7. Measure part dimensions and angles.
8. Check part dimensions to tolerance.

DUTY F: PERFORMING PRECISION MEASUREMENT

15. TASK: Measure parts with height gage

PERFORMANCE OBJECTIVE

Provided with parts, drawings, and precision measuring instruments, measure parts. Tolerance is + or - 0.001".

TOOLS AND EQUIPMENT

Vernier height gage
Attachments
Surface plate
Files
Cleaner

PERFORMANCE GUIDE

1. Deburr and clean the parts.
2. Clean surface plate.
3. Set part on surface plate.
4. Set height gage on plate.
5. Assemble necessary parts to height gage, offset scribe, indicator, etc.
6. Check zero reference setting of gage.
7. Slide vernier scale so scribe or indicator is just above the part.
8. Lock vernier scale.
9. Fine adjust until scriber or indicator touches part.
10. Lock fine adjustment screw.
11. Use magnifying glass as needed to read vernier scale.

DUTY F: PERFORMING PRECISION MEASUREMENT

16. TASK: Measure parts using optical comparators

PERFORMANCE OBJECTIVE

Provided with part, template or comparator charts, and drawings, check the part on the comparator. Part must fit the template or chart to within + or - 0.001" and + or - 1 degree, or meet specifications.

TOOLS AND EQUIPMENT

Part
Dial indicator
Other assorted parts as
  comparator needs
Optical comparator
Template or charts

PERFORMANCE GUIDE

1. Mount necessary attachments.
2. Mount magnification lens.
3. Turn on comparator.
4. Mount workpiece either on centers or in vee on riser block.
5. Align part with dial indicator.
6. Mount necessary template or chart and focus.
7. Measure part dimensions and angles.
8. Check part dimensions to tolerance.

DUTY F: PERFORMING PRECISION MEASUREMENT

17. TASK: Inspect parts with comparison measuring tools

PERFORMANCE OBJECTIVE

Provided with parts, part drawing, and radius gages, thread gages, go/no go gages, and surface finish comparator, inspect and measure parts. Measurement shall meet specifications.

TOOLS AND EQUIPMENT

Radius gage
Thread gage
Go/no go gage
Surface finish gage

PERFORMANCE GUIDE

1. Choose tool for application, thread gage for thread, radius gage for radius comparison, etc.
2. Inspect or compare part to gage and drawing.
3. Hold gage firmly but do not force contact.
4. Determine matches or mismatches.
5. Determine approximate error.
6. Clean tools and return to storage.

DUTY F: PERFORMING PRECISION MEASUREMENT

18. TASK: Inspect parts with precision measuring tools

PERFORMANCE OBJECTIVE

Provided with parts, outside micrometers, depth gages, dial indicators, inside micrometers, measure parts to standard tolerance of drawing or precision instrument.

TOOLS AND EQUIPMENT

Micrometers
Depth gage
Indicators
Inside micrometers

PERFORMANCE GUIDE

1. Choose measuring tool for the application.
2. Check part dimensions on drawing.
3. Measure part using light touches on measuring tool to not obtain precision reading, record readings.
4. Remeasure part for verification of measurement.
5. Properly clean and store measuring tool.

DUTY F: PERFORMING PRECISION MEASUREMENT

19. TASK: Measure parts with semi-precision measuring tools

PERFORMANCE OBJECTIVE

Provided with a part, part drawing, tape measure, steel rule, calipers, and dial calipers, measure part to tolerances allowable with semi-precision tools.

TOOLS AND EQUIPMENT

Tape measure
Steel rule
Calipers
Dial calipers

PERFORMANCE GUIDE

1. Choose measuring tool to meet the measurement requirements.
2. Measure part.
3. Check part dimension to drawings.

DUTY G: PERFORMING BENCHWORK

1. TASK: Supervise assembly operations

PERFORMANCE OBJECTIVE

Provided with drawings, specifications, assembly operations list, and parts, supervise the assembly of part to meet specifications and time allotments.

TOOLS AND EQUIPMENT

Drawings
Specifications
Lists
Assorted assembly tools

PERFORMANCE GUIDE

1. Safely set up assembly area.
2. Study assembly operations and drawings.
3. Organize work area, parts, and personnel.
4. Check assembly at important intervals.
5. Final check assembly.

DUTY G: PERFORMING BENCHWORK

2. TASK: Plan assembly operations

PERFORMANCE OBJECTIVE

Provided with part drawings and part specifications, plan assembly operations. Include tools necessary to perform operations.

TOOLS AND EQUIPMENT

Drawings
Specifications list
Schedule

PERFORMANCE GUIDE

1. Study drawings and specifications.
2. Determine sequence of operations.
3. Determine time allotted for assembly operations.
4. Record operations on form or forms that can be read and understood.
5. Review operations and selections of tooling or tools to assemble.

DUTY G: PERFORMING BENCHWORK

3. TASK: Repair handtools

PERFORMANCE OBJECTIVE

Provided with handtools and job specifications or the manufacturers standards, inspect and repair handtools. Tools shall meet specifications or manufacturers standards.

TOOLS AND EQUIPMENT

Files
Saws
Hammers
Chisels
Taps
Hand reamers
Pliers
Vises
Screwdrivers
Wrenches
Dies

PERFORMANCE GUIDE

1. Inspect appropriate tool and determine extent of damage.
2. Determine method of repair.
3. Check clearances and edges.
4. Obtain any needed parts.
5. Disassemble and replace damaged part.
6. Make necessary adjustments.
7. Sharpen dull tools.
8. Remove any burrs or mushroomed heads.
9. Regrind tools to proper shapes or clearances.

DUTY G: PERFORMING BENCHWORK

4. TASK: Assemble and repair gages

PERFORMANCE OBJECTIVE

Provided with assorted gages, inspect, disassemble, repair, if necessary, and assemble. Inspect accuracy, and match gage to manufacturers standards and specifications.

TOOLS AND EQUIPMENT

Gages
Magnifying glass
Lubricant
Specifications

Jewelers tool set
Bulb blower
Cleaner

PERFORMANCE GUIDE

1. Inspect gage for damage.
2. Choose correct tool for disassembly.
3. Disassemble gage.
4. Inspect internal parts for damage.
5. Clean parts.
6. Remove necessary parts.
7. Repair or replace parts.
8. Lubricate parts.
9. Assemble gage.
10. Inspect and test gage to standards.

DUTY G: PERFORMING BENCHWORK

5. TASK: Repair cutting tools

PERFORMANCE OBJECTIVE

Provided with cutting tools and job specifications and tooling specifications, inspect and make needed repairs. Cutting tools must meet manufacturers standards and specifications.

TOOLS AND EQUIPMENT

Allen wrenches
Brushes
Magnifying glass
Cleaner
Cloths
Gages
Indicators

PERFORMANCE GUIDE

1. Inspect for cracks, burnt edges, broken surfaces, incorrect clearances, damaged seats, and clamping parts.
2. Remove bad parts or cutter surfaces.
3. Send cutters out for grinding and/or rebuilding.
4. Replace broken parts or inserts.
5. Inspect clearances.
6. Inspect for proper seating.

DUTY G: PERFORMING BENCHWORK

6. TASK: Assemble cutting tools

PERFORMANCE OBJECTIVE

Provided with assorted cutting tools and specifications, assemble tools safely and correctly. Tools must meet part drawing and tooling specifications.

TOOLS AND EQUIPMENT

Counterbores
Milling cutters
Turning tools
Scrapers
Boring tools

PERFORMANCE GUIDE

1. Assemble counterbores to meet drawing callouts.
2. Assemble assorting milling cutters, insert holders, and others to meet drawing callouts and machining principles.
3. Assemble turning tools, both fixed and insert holders to meet specifications.
4. Assemble assorted handtools to perform intended functions.
5. Assemble assorted boring bars, for lathes, and boring machines, drillpresses to conform to specifications.

DUTY G: PERFORMING BENCHWORK

7. TASK: Repair metalworking dies

PERFORMANCE OBJECTIVE

Provided with drawings and a die in need of repair, check clearances, and restore die to operable condition.

TOOLS AND EQUIPMENT

Feeler gages
Wrenches
Hones
Punches
Surface grinder
Indicators
Measuring tools
Cleaner
Files
Shim stock
Prussion blue

PERFORMANCE GUIDE

1. Inspect and check clearances.
2. Disassemble die parts.
3. Clean parts.
4. Surface grind or polish necessary parts.
5. Reassemble die, using shim stock where necessary.
6. Check clearances.
7. Test run and debug.

DUTY G: PERFORMING BENCHWORK

8. TASK: Fit and assemble metalworking dies

PERFORMANCE OBJECTIVE

Provided with die parts and assembly drawing, assemble necessary parts and fit to tolerances of + or - 0.0001" or specifications provided.

TOOLS AND EQUIPMENT

Measuring tools
Punches
Hammers
Cleaner
Stones
Sets
Allen wrenches
Magnifying glass
Files

PERFORMANCE GUIDE

1. Check parts to print.
2. Deburr and clean, if necessary.
3. Determine die part locations.
4. Assemble parts in order.
5. Check clearances with feeler stock.
6. Test run and debug.

DUTY G: PERFORMING BENCHWORK

9. TASK: Repair jigs and fixtures

PERFORMANCE OBJECTIVE

Provided with used and or damaged fixtures, make necessary repairs to meet drawing specifications of part(s).

TOOLS AND EQUIPMENT

Assorted measuring instruments
Assorted wrenches
Punches
Hammer
Brass sets

PERFORMANCE GUIDE

1. Inspect fixture for damage.
2. Measure location points.
3. Disassemble necessary parts.
4. Repair damaged parts, if possible, or order parts from other areas.
5. Order replacement vendor parts, where necessary.
6. Reassemble fixture and test.

DUTY G: PERFORMING BENCHWORK

10. TASK: Assemble jigs and fixtures

PERFORMANCE OBJECTIVE

Provided shop drawings, sample part, fixturing parts, and materials, assemble a jig or fixture to correct standards and procedures to manufacture a part to specifications. Part locations must be within 0.001".

TOOLS AND EQUIPMENT

Drillpress
Punch
Assorted wrenches and drivers
Files
Brass sets
Dowel pins
Indicators
Stones

PERFORMANCE GUIDE

1. Layout fixture parts in order of assembly.
2. Deburr and clean parts.
3. Locate reference zero points.
4. Puch, drill, and install dowel pin at zero.
5. Drill necessary hold, and tap necessary holes.
6. Assemble parts.
7. Inspect and measure locations.
8. Mount and run tast part(s).

DUTY G: PERFORMING BENCHWORK

11. TASK: Lift and position workpiece

PERFORMANCE OBJECTIVE

Provided with part(s) and application or need, perform safe and correct lifting and positioning procedures, in demonstration and normal daily operations.

TOOLS AND EQUIPMENT

Part(s) and carts
Straps
Overhead lifts
Wood spacers or metal parallels

PERFORMANCE GUIDE

1. Pick up and position parts by hand.
2. Use die cart or other mechanical method to safely lift and position part(s).
3. Use overhead lift with straps to lift and position part(s).
4. Do not lift more than company policy indicates.

DUTY G: PERFORMING BENCHWORK

12. TASK: Apply specified surface in hole (hand ream)

PERFORMANCE OBJECTIVE

Provided with part drawings, part(s), hand reamer and tools, hand ream a hole in the part(s) to a tolerance of + 0.0005" or - 0.0000" or to drawing specifications.

TOOLS AND EQUIPMENT

Reamers
Work-holding device
Square
Tap wrench
Lubricant
Inspection instruments
Gages

PERFORMANCE GUIDE

1. Clamp or mount part.
2. Select reamer and check size.
3. Select tap wrench and mount reamer.
4. Ream hole.
5. Check for squareness and straightness.
6. Use lubricant/cutting fluid.
7. Use light downward pressure.
8. Check dimensions of hole.
9. You may use a stub center and drillpress to support the tail of the reamer and apply downward pressure.

DUTY G: PERFORMING BENCHWORK

13. TASK: Cut keyways using hand broaching tools

PERFORMANCE OBJECTIVE

Provided with part drawings, part(s), and equipment, broach part for keyway. Tolerances are + or - 0.001" on all decimal dimensions, or + or - 1/64" on all fractional dimensions, or meet drawing specifications.

TOOLS AND EQUIPMENT

Arbor press
Broaching tools and accessories
Work supports
Precision measuring tools
Key stock

PERFORMANCE GUIDE

1. Deburr and clean part(s).
2. Mount part in supports on arbor press.
3. Select broach per specs.
4. Align part and broach, checking vertical and location.
5. Press broach through part, using shims provided on each successive pass.
6. Check dimensions and repeat steps necessary.
7. Deburr edges.
8. Inspect part, and make corrections needed.

DUTY G: PERFORMING BENCHWORK

14. TASK: Straighten parts

PERFORMANCE OBJECTIVE

Provided with bent part(s) and equipment, straighten the part(s). The part(s) must be within a tolerance of 0.002" TIP upon completion.

TOOLS AND EQUIPMENT

Arbor press
Dial indicators
Clamping devices, if necessary
Various assorted support blocks

PERFORMANCE GUIDE

1. Check part runout with indicators.
2. Mark location of runout.
3. Mount part in the arbor press.
4. Apply force on high spot (overbend to allow for spring back).
5. Inspect part for straightness.
6. Repeat steps as necessary to bring part(s) within tolerance of 0.002" or specifications.

DUTY G: PERFORMING BENCHWORK

15. TASK: Lap and fit parts

PERFORMANCE OBJECTIVE

Provided with finished parts, part drawings, and lapping tools and equipment, lap the indicated surfaces of the part. The surface(s) must be within the tolerances of a 32 to 16 micro-inches in the roughness average. A maximum of 0.005" TIP shall be allowed.

TOOLS AND EQUIPMENT

Lapping block
Assorted abrasives
Lubricant
Indicator holders
Profilomitor
Lapping plate
Surface finish gage
Indicators
Surface roughness comparator

PERFORMANCE GUIDE

1. Deburr and clean part(s).
2. Select proper lapping block and tools.
3. Select lapping compounds.
4. Polish with abrasive cloth if part not surface ground.
5. Rough lap, if necessary.
6. Move part or lap in figure eight motion.
7. Use light and even pressures.
8. Cover entire surface in motion.
9. Clean entire surface before adding fresh lap.
10. Clean surface and check for accuracy and finish.
11. Repeat steps necessary to achieve finish and accuracy.

DUTY G: PERFORMING BENCHWORK

16. TASK: Remove high spots

PERFORMANCE OBJECTIVE

Provided with part drawing and workpiece, handscrape the workpiece. The scraped surface must meet drawing specifications.

TOOLS AND EQUIPMENT

Surface plate
Scrapers
Lubricant
Cleaner
Grinder
Oilstone
Prussion blue
Work-holding devices

PERFORMANCE GUIDE

1. Deburr and clean the part.
2. Select scraper.
3. Sharpen scraper, if needed.
4. Clean part surface, if not already checked for high spots.
5. Apply Prussion blue, if needed.
6. Proceed to check for high spots, if not already located.
7. Scrape Prussion blue spots on part removing .002" to .003" at a time.
8. Use short strokes.
9. Clean part and scraper.
10. Repeat steps necessary to remove all high spots.

DUTY G: PERFORMING BENCHWORK

17. TASK: Determine high spots

PERFORMANCE OBJECTIVE

Provided with part drawings and workpiece, determine the location of high spots. Mark the location of each high spot.

TOOLS AND EQUIPMENT

Surface plate
Straight edges
Work-holding device
Dial indicators
Prussion blue
Vernier height gage

PERFORMANCE GUIDE

1. Deburr and clean the workpiece.
2. Apply Prussion blue.
3. Run the straight edge corner to corner.
4. Mark high spots.
5. Lightly rub part in figure eight pattern on surface plate.
6. Use dial indicator mounted on height gage and traverse surface.
7. Recheck for high spots.

DUTY G: PERFORMING BENCHWORK

18. TASK: Finish parts with hand grinders

PERFORMANCE OBJECTIVE

Provided with workpiece, parts drawing, and grinding equipment, finish grind part by hand. Surfaces must meet drawing specifications.

TOOLS AND EQUIPMENT

Portable grinder
Wheels
Clamping devices
Wheel chart

PERFORMANCE GUIDE

1. Mount workpiece.
2. Check drawing for surface to be finished.
3. Select grinding wheels.
4. Ring test all wheels.
5. Mount wheels.
6. Grind part or parts.
7. Inspect surfaces and measure dimensions to drawing.

DUTY G: PERFORMING BENCHWORK

19. TASK: Rough grinding parts with hand grinders

PERFORMANCE OBJECTIVE

Provided with a workpiece, part drawing, and grinding equipment, grind workpiece by hand. Ground surfaces must meet drawing specifications.

TOOLS AND EQUIPMENT

Portable grinder
Assorted wheels
Clamps
Grinding chart

PERFORMANCE GUIDE

1. Mount part in work-holding device or fixture.
2. Check drawing.
3. Select grinding wheel and check speeds.
4. Ring test wheels.
5. Mount wheel on grinder on guards in place.
6. Wear safety goggles.
7. Grind surfaces.
8. Check part surfaces to drawing.

DUTY G: PERFORMING BENCHWORK

20. TASK: Use hand filing machines to rough finish parts

PERFORMANCE OBJECTIVE

Provided with workpiece, part drawing and filing machine, file part by hand. Rough filed surface must meet drawing specifications.

TOOLS AND EQUIPMENT

Filing machine
File assortment
Clamping devices
Charts

PERFORMANCE GUIDE

1. Mount work on filing table or suitable device.
2. Check drawing for surface details.
3. Set filing speeds.
4. Select files to use.
5. File surfaces.
6. Check surfaces to drawing.

DUTY G: PERFORMING BENCHWORK

21. TASK: Sharpen and polish tools

PERFORMANCE OBJECTIVE

Provided with various cutting tools, job specifications and abrasive stones, hand sharpen the cutting tools to job specifications.

TOOLS AND EQUIPMENT

Oilstones (hones)
Slip stones
Lubricant
Diamond dust
Diamond wheels

PERFORMANCE GUIDE

1. Select oilstone.
2. Hone cutting edges.
3. Apply lubricant, where needed.
4. Repeat steps, where needed.
5. Use diamond wheels carefully with light pressure, where needed.
6. Inspect tools for proper clearance and edges.

DUTY G: PERFORMING BENCHWORK

22. TASK: Polish parts

PERFORMANCE OBJECTIVE

Provided a workpiece, part drawing, polishing tools and equipment, polish part to drawing specifications.

TOOLS AND EQUIPMENT

Abrasive cloths
Die grinder
Appropriate machine tools
Buffer
Abrasive sticks
Surface finish indicator

PERFORMANCE GUIDE

1. Determine method of polishing according to drawing.
2. Select appropriate abrasive.
3. Set machine tools to correct cutting speed for polishing.
4. Polish part.
5. Use a file or board for backup pressure.
6. Check sizes to drawing.
7. If buffing, select wheel and compound.
8. Choose clamping procedures.
9. Check surface for loaded buffer marks and finish.
10. Check part against drawing specifications.
11. Use appropriate safety devices and procedures.

DUTY G: PERFORMING BENCHWORK

23. TASK: Deburring parts

PERFORMANCE OBJECTIVE

Provided with workpieces that have sharp edges and burrs, remove and break edges. Edges must be broken to a minimum of .005 or meet drawing specifications.

TOOLS AND EQUIPMENT

Assorted files
Abrasive cloth
Scrapers
Glass bead machine
Vibratory deburring machine
Whet stones
Die grinder
Deburring tools
Shot peen machine

PERFORMANCE GUIDE

1. Secure part.
2. Choose correct tool to deburr to drawing specifications.
3. Deburr all edges and break corners.
4. Check for shart burrs, carefully.
5. Check drawing callouts.
6. Use appropriate safety devices and procedures.

DUTY G: PERFORMING BENCHWORK

24. TASK: Remove damaged fasteners and repair threads

PERFORMANCE OBJECTIVE

Provided with workpiece having a broken or damaged screw, remove the damaged part. The fit of the original hole must be maintained.

TOOLS AND EQUIPMENT

Electric drill
Drill rack
Taps
Extractors
Clamps
Center drill
Drillpress or EDM or Tap buster
Charts
Tap wrench
Punches
Lubricant
Helicoil, if needed

PERFORMANCE GUIDE

1. Secure workpiece.
2. Center punch damaged screw or bolt.
3. Center drill damaged part.
4. Determine thread for LH or RH.
5. Select drill and extractor, and drill hole.
6. Remove damaged bolt or screw.
7. Use slight downward pressure on extractor.
8. Use lubricant.
9. Turn correct direction.
10. Clean hole, and re-thread.
11. Check hole for proper measures to save integrity of fit (i.e., drill over size and plug hole, weld and re-drill and tap).

DUTY G: PERFORMING BENCHWORK

25. TASK: Cut threads with hand taps and dies

PERFORMANCE OBJECTIVE

Provided with a workpiece and part drawing, hand tap workpiece and use dies to cut external threads. Threaded workpieces must fit gages within tolerance and meet drawing specifications.

TOOLS AND EQUIPMENT

Drillpress
Hand taps and dies
Lubricants
Hammer
Drills
References
Work-holding devices
Tap wrenches
Punches
Gages
Layout tools
Countersink

PERFORMANCE GUIDE

1. Clamp workpiece.
2. Locate hole position and punch.
3. Select tap drill and drill hole.
4. Select tap wrench and tap, or die and die holder.
5. Tap hole or chase threads on shaft.
6. Check for vertical alignment of tap or horizontal plane of die.
7. Turn ½ to one full turn clockwise motion (RH threads).
8. Back out tap or die enough to break chips.
9. Clear chips, if necessary, and repeat process.
10. Inspect threads to gages or mating parts.

DUTY H: OPERATING MILLS

1. TASK: Locate and mill a pocket in the part

PERFORMANCE OBJECTIVE

Provided with part(s), drawing, mill and accessories, locate and mill a pocket in the part. Part must meet tolerance of + or - 0.001".

TOOLS AND EQUIPMENT

Milling machine
Work-holding device
End mill
Measuring tools
Toolholder
Handbook

PERFORMANCE GUIDE

1. Identify material.
2. Mount and align vise, etc.
3. Locate zero, and locate pocket from zero.
4. Set operating conditions.
5. Plunge into part to roughing depth.
6. Make roughing cut.
7. Measure progress and contour of pocket.
8. Make adjustments and finish part.
9. Inspect part to specifications.

DUTY H: OPERATING MILLS

2. TASK: Establish zero reference point

PERFORMANCE OBJECTIVE

Provided with mill, aligned vise, part, and drawing, locate mill to zero reference point. Location must be within + or - 0.0002".

TOOLS AND EQUIPMENT

Milling machine
Vise or clamps
Edgefinder

PERFORMANCE GUIDE

1. Place part and secure in aligned vise or fixture.
2. Place edgefinder in mill collet and snug.
3. Set rpm to 800-1000rpm.
4. Align edgefinder with part corner edge.
5. Zero dials.
6. Dial into part and watch for edgefinder to move off center.
7. Zero dials, and dial over ½ diameter of edgefinder.
8. Repeat steps for adjacent edge.
9. Zero dials after moving in ½ of diameter of edgefinder.

DUTY H: OPERATING MILLS

3. TASK: Align milling fixtures with an indicator

PERFORMANCE OBJECTIVE

Given a milling fixture, milling vise, place either on the mill table and align to + or - 0.0001" total runout.

TOOLS AND EQUIPMENT

Vise
Clamping bolts
Wrench
Indicator
Plastic mallet
Square

PERFORMANCE GUIDE

1. Clean mill table and bottom of vise.
2. Align vise by sight, sight T-slots to vise base slots.
3. Snug vise lightly.
4. Install indicator in mill quill.
5. Touch off indicator on solid vise jaw.
6. Check each end of solid jaw and record runout.
7. Tap vise one way or another to correct ½ of runout.
8. Repeat steps as needed until vise is aligned.
9. Snug clamp bolts.
10. Recheck alignment.

DUTY H: OPERATING MILLS

4. TASK: Align vertical head

PERFORMANCE OBJECTIVE

Provided with indicators, handtools, and milling machine, align vertical head. The head must be aligned to a tolerance of 0.0001" runout in 4".

TOOLS AND EQUIPMENT

Milling machine
Magnetic base
Hex wrench
Rag
Dial indicator
Plastic mallet
Mill wrench

PERFORMANCE GUIDE

1. Lower quill 3" and lock.
2. Wipe table clean and place ground plate on table.
3. Attach indicator bar in collet of mill.
4. Attach indicator to bar.
5. Raise knee of mill so indicator contacts ground plate, and raise 0.015".
6. Sweep indicator around in 180 degree segments, checking runout.
7. Loosen head locks just to release tension.
8. Crank work gear on adjustment mechanism to correct for ½ of runout error.
9. Snug locks.
10. Recheck steps for accuracy.
11. Repeat steps as needed to obtain aligned vertical head.

DUTY H: OPERATING MILLS

5. TASK: Set operating conditions

PERFORMANCE OBJECTIVE

Provided with part drawing, specifications, and material, set operating conditions for the milling machine. Include speeds, feeds, depth of cuts.

TOOLS AND EQUIPMENT

Milling machine
Machinery's handbook
Charts

PERFORMANCE GUIDE

1. Look up recommended rates in the handbook.
2. Check tool manufacturer's guidebooks.
3. Set controls on the milling machine.
4. Cut part and make adjustments, as needed.

DUTY H: OPERATING MILLS

6. TASK: Select proper milling cutters

PERFORMANCE OBJECTIVE

Provided with part drawing and operations sheets, select correct milling cutter and toolholder for the operations to be performed.

TOOLS AND EQUIPMENT

Assorted milling cutters
Tool-holders

PERFORMANCE GUIDE

1. Study drawing for operations, sizes, and types of cutters needed.
2. Determine best tool selection.
3. Determine Tool-holders to use with each tool.
4. Check tools and holders for unnecessary wear.
5. Install tools into holders, or onto holders.

DUTY H: OPERATING MILLS

7. TASK: Machine angles

PERFORMANCE OBJECTIVE

Provided with drawing, part(s), and a milling machine, mill part to an angle. Part must meet tolerance of + or - 0.001" and + or - five minutes.

TOOLS AND EQUIPMENT

Milling machine
Angle plate
Sine bar
Bevel protractor
Milling cutter
Part
Clamps
Gage blocks
Surface plate
Machinery's handbook

PERFORMANCE GUIDE

1. Mount angle plate on surface plate.
2. Calculate gage block stack for the sine bar.
3. Select and ring gage blocks.
4. Place gage blocks and sine bar against angle plate.
5. Place part on sine bar and clamp to angle plate.
6. Determine part material.
7. Set operating conditions.
8. Select and mount cutter.
9. Mount angle plate on clean mill table.
10. Clamp and align.
11. Make cut.
12. Check tolerance and angle, make adjustments.
13. Machine to specifications.

DUTY H: OPERATING MILLS

8. TASK: Machine radii

PERFORMANCE OBJECTIVE

Provided with part drawing, premilled part, milling machine, cut radius on part to drawing specifications and a tolerance of + or - 0.005".

TOOLS AND EQUIPMENT

Milling machine
Rotary table
Clamps
Dial indicator
Prepared workpiece
End mill
Step blocks
Vernier calipers

PERFORMANCE GUIDE

1. Determine part material.
2. Place rotary table on milling machine.
3. Center mill spindle over rotary table with dial indicator.
4. Align and clamp part to rotary table.
5. Select and install cutter.
6. Set operating conditions.
7. Locate start of radii.
8. Touch off work and feed in depth of cut.
9. Make rough pass.
10. Measure part.
11. Make adjustments.
12. Finish cut part.
13. Deburr and inspect.

DUTY H: OPERATING MILLS

9. TASK: Machine various slots

PERFORMANCE OBJECTIVE

Provided with part drawings, part(s), T-slot cutters, dovetail cutters, various end mills, cut keyways, T-slots, and dovetail slots. Part sections must meet drawing callout, and tolerance of + or - 0.002".

TOOLS AND EQUIPMENT

Milling machine
T-slot cutter
Measuring tools
Clamps and vise
End mill
Dovetail cutter
Assorted tools
Dial indicator

PERFORMANCE GUIDE

1. Mount Work-holding device and align.
2. Mount part and align.
3. Install selected cutter.
4. Establish zero with cutter.
5. Set operating conditions.
6. Locate slot in correct relation to zero.
7. Set depth of cut.
8. Apply cutting fluid liberally.
9. Make roughing pass.
10. Be sure to rough out slots with end mill prior to use of T-slots, and dovetail cutters.
11. Measure and make adjustments.
12. Make needed finish passes.

DUTY H: OPERATING MILLS

10. TASK: Centerdrill and drill holes

PERFORMANCE OBJECTIVE

Provided with part, drawing, mill, and accessories, centerdrill and drill holes to specs. Tolerances are + or - 1/64" on fractions and + or - 0.003 on decimals.

TOOLS AND EQUIPMENT

Mill
Mallet
Edgefinder
Centerdrill
Drill chuck
Calipers
Work-holding devices
Dial indicator
Hole gage
Drills
Micrometer
Machinery's handbook

PERFORMANCE GUIDE

1. Mount and align part in Work-holding device.
2. Secure part.
3. Mount drill chuck.
4. Align over hole location.
5. Set operating conditions.
6. Centerdrill hole, apply cutting fluid.
7. Remove centerdrill and place twist drill in chuck.
8. Drill hole to depth, clearing chips, and using cutting fluid.
9. Measure part.
10. Locate to next hole and repeat steps.
11. Steps 6 and 7 may be changed to centerdrill all holes first and then drill all holes.
12. Deburr, clean, and inspect part.

DUTY H: OPERATING MILLS

11. TASK: Drill and ream holes

PERFORMANCE OBJECTIVE

Provided with part, part drawing, mill and accessories, and measuring tools, drill and ream holes. Part must meet tolerance of + 0.0005" and - 0.0000" on holes or drawing specs.

TOOLS AND EQUIPMENT

Milling machine
Fixturing
Reamers
Centerdrill
Micrometer
Part
Drills
Drill chuck
Hole gage
Handbook

PERFORMANCE GUIDE

1. Mount and align fixture, dial indicate.
2. Place part in fixture.
3. Mount drill chuck.
4. Select proper tools.
5. Locate to hole location.
6. Set operating conditions.
7. Centerdrill.
8. Drill hole.
9. Ream hole.
10. Use cutting fluid.
11. Deburr, measure hole, and inspect, as needed.

DUTY H: OPERATING MILLS

12. TASK: Tap holes

PERFORMANCE OBJECTIVE

Provided with part drawing, part, mill, and assorted tools, drill and tap holes. Hole location must meet tolerance of + or - 0.001" and threads shall fit go/no go gage.

TOOLS AND EQUIPMENT

Mill
Drill
Cutting fluid
Assorted tools
Centerdrill
Tap
Go/no go gage
Tap drill chart

PERFORMANCE GUIDE

1. Mount part in appropriate holding device.
2. Locate hole position.
3. Select centerdrill.
4. Select drill and tap.
5. Set operating conditions.
6. Install drill chuck.
7. Centerdrill and drill part.
8. Install tap in chuck.
9. Apply cutting fluid.
10. Job spindle clockwise.
11. Apply light downward pressure with quill feed handle.
12. Jog in reverse as tap reaches depth.
13. Clear chips.
14. Measure threads with gage.

DUTY H: OPERATING MILLS

13. TASK: Bore diameters

PERFORMANCE OBJECTIVE

Provided with part, drawing, and milling machine, bore holes in part. Part must meet tolerance of + or - 1/64" on fractional dimensions, and + or - 0.001" on decimals and/or meet drawing specifications.

TOOLS AND EQUIPMENT

Vertical mill
Edge finder
Drill
Telescope gage
Adjustable boring head
Assorted tools
Holding devices
Center drill
Drill chuck
Micrometer
Boring bar

PERFORMANCE GUIDE

1. Mount part on mill.
2. Mount edge finder in mill collet or chuck.
3. Locate reference zero, and hole location.
4. Centerdrill, and drill hole.
5. Drill large hole to allow boring bar to fit.
6. Select boring bar.
7. Install adjustable boring head and tool in spindle.
8. Calculate and set amount of cut by adjusting boring head out with micrometer dial on head.
9. Select operating conditions.
10. Start mill and take trial cut, measure hole, and make adjustments to machine and bar.
11. Measure bored hole and continue to completion of hole.
12. Remove burrs and inspect part.

DUTY H: OPERATING MILLS

14. TASK: Face parts with offset boring head

PERFORMANCE OBJECTIVE

Provided with part, drawing, mill, and offset boring head, face a surface and/or diameter on the part. Surface must meet tolerance of drawing specifications and tolerances.

TOOLS AND EQUIPMENT

Milling machine
Part
Measuring tools
Offset boring head
Assorted tools
Clamping devices

PERFORMANCE GUIDE

1. Set up part.
2. Set operating conditions.
3. Mount boring head in spindle.
4. Install tool in proper cutting direction.
5. Touch off part to achieve reference zero, and dial in depth of cut from knee or saddle.
6. Place feed bar in hole in collar on boring head.
7. Turn on mill, hold bar until head faces out to desired diameter.
8. Pull out bar to stop feed action.
9. Measure part and make adjustments in depth.
10. Repeat steps as necessary to complete part.
11. Deburr, inspect, and measure part.

DUTY H: OPERATING MILLS

15. TASK: Recess faces or diameters with offset boring head

PERFORMANCE OBJECTIVE

Provided with part, drawing, vertical or horizontal mill, and offset boring head, recess bore or counterbore with offset boring head to specified diameter and depth as per drawing callouts and tolerances.

TOOLS AND EQUIPMENT

Offset boring head
Measuring tools
Clamps and parallels or vise
Milling machine
Assorted tools
Dial indicator

PERFORMANCE GUIDE

1. Set up part.
2. Locate with indicator center of flange or diameter to recess.
3. Mount boring head in spindle.
4. Set operating conditions.
5. Determine recess specifications.
6. Set tool of boring head to inside smallest diameter of flange or surface.
7. Calculate the number of clicks of the feed mechanism it will take to feed to diameter of recess.
8. Dial in knee or saddle for depth of cut.
9. Place feed bar in hole on boring head.
10. Turn on mill and hold feed bar firmly in hand.
11. Count clicks, pull out bar two or three clicks short of calculated clicks.
12. Measure bore for depth and diameter.
13. Lock boring head after using micrometer adjustment to move head out to desired diameter.
14. Use offset boring head as a normal boring bar to finish recess to diameter, hand feed knee or use light power feed. (Use layout die to mark bottom of recess.) Stop infeed as tool picks up steel ink.
15. Deburr and inspect part.

DUTY H: OPERATING MILLS

16. TASK: Perform indexing operations

PERFORMANCE OBJECTIVE

Provided with part, drawing, and mill with indexing head, calculate indexing and machine part using indexing head to locate surfaces for machining. Part must meet drawing specifications and tolerances.

TOOLS AND EQUIPMENT

Milling machine
Hole plates
(drive dog)
Dial indicator
Measuring tools

Indexing Head
(Foot stock)
Milling cutter
Test bar
Assorted tools and machinery's handbook

PERFORMANCE GUIDE

1. Determine part material.
2. Place indexing head on mill and align head with indicator and test bar if available or part if not available.
3. Select and install milling cutter.
4. Calculate number of indexes and correct hole plate.
5. Set up indexing head for index operation.
6. Set operating conditions.
7. Center cutter over the part.
8. Dial over ½ part plus ½ cutter width.
9. Touch off part, move up depth, make primary cut.
10. Measure and adjust for depth.
11. Index part with crank handle on indexing head number of calculated turns and partial turns (holes).
12. After reaching beginning cut, measure and repeat steps as needed to finish part.

DUTY H: OPERATING MILLS

17. TASK: Identify and correct mill problems

PERFORMANCE OBJECTIVE

Provided with mill and operations, identify problems and correct machine and machining problems.

TOOLS AND EQUIPMENT

Milling machine

PERFORMANCE GUIDE

1. Set up jobs on mill.
2. Identify machine problems.
3. Correct machine problems.
4. Analyze problems in machining operations and tools.
5. Correct machining problems by repairing cutter, or adjusting speeds and feeds, or readjusting clamps, or absorbing vibrations, or clearing chips, or whatever else is determined to cause problem.

DUTY H: OPERATING MILLS

18. TASK: Maintain milling machine

PERFORMANCE OBJECTIVE

Provided with milling machine, operator's manual, and tools and rags, clean, lubricate, and adjust the mill. Clean and refill coolant system. Must be performed to operator's manual specifications.

TOOLS AND EQUIPMENT

Mill
Rags
Lubricants
Screwdrivers
Cleaner
Brush
Wrenches

PERFORMANCE GUIDE

1. With mill running check oil levels and gages.
2. Turn off power.
3. Clean mill and coolant sump.
4. Wipe mill with rags.
5. Lubricate mill to manual specs.
6. Oil regularly as per manual.
7. Oil in organized manner, not missing any oil or grease ports.
8. Check sight gages for oil level.
9. Inspect hand or auto oilers.
10. Inspect and clean and replace filters, as needed.
11. Clean and oil all sliding surfaces.
12. Lube drive chain, if applicable.
13. Lube all bearings, as needed.
14. Check and adjust all gibs.
15. Clean coolant sump and refill.
16. Dispose of all rags and solvents in a safe manner.

DUTY H: OPERATING MILLS

19. TASK: Plan sequence of operations

PERFORMANCE OBJECTIVE

Provided with drawings, plan a complete sequence of operations for the milling operations on the part, interface with other preliminary processes, and following processes.

TOOLS AND EQUIPMENT

Drawings (optional)

PERFORMANCE GUIDE

1. Study drawings for materials and details.
2. Determine sequence of operations and optimize tool path and machine time.
3. Record sequence on proper forms.
4. Review for corrections.

DUTY H: OPERATING MILLS

20. TASK: Change arbors and cutters

PERFORMANCE OBJECTIVE

Provided with a milling machine, assorted cutters, and milling machine arbors, change arbors and cutters for different operations and cutters.

TOOLS AND EQUIPMENT

Milling machine
Assorted milling cutters that mount on arbors
Arbors and arbor supports

PERFORMANCE GUIDE

1. Determine cutter and matching arbor needs for the job.
2. Loosen draw bar at end of spindle hole.
3. Tap end of draw bar with soft hammer to break loose the taper.
4. Unscrew draw bar from arbor, while holding the arbor in opposite hand, not allowing it to drop.
5. Remove arbor from spindle hole.
6. Select draw bar for application.
7. Wipe tapered end clean with rag.
8. Wipe out the spindle hole with a rag.
9. Place arbor in spindle hole and align drive dogs with slots in arbor, and screw draw bar into arbor, snug draw bar.
10. Select cutter and install on arbor, holding cutter in a rag in your hand.
11. If on a horizontal mill, install spacing collars with keys on either side of cutter to locate cutter.
12. Install outboard bearing and support, and arbor nut in order.
13. If using other arbor styles, mount cutter and secure with clamping nut.
14. Turn on machine and check arbor for runout.

DUTY H: OPERATING MILLS

21. TASK: Perform horizontal milling operations

PERFORMANCE OBJECTIVE

Provided with part drawing, part, mill with accessories, measuring tools, perform straddle milling, gang milling, step milling, deep slots, and cutoff operations. Part must meet drawing specifications.

TOOLS AND EQUIPMENT

Milling machine
Side milling cutters
Arbor
Micrometer
Spacing collar
Slotting cutters
Vise
Matched pair cutters
Parallels
Soft faced hammer
Dial indicator
Cutoff saws

PERFORMANCE GUIDE

1. Determining part material.
2. Select cutters.
3. Set operating conditions.
4. Mount cutters on arbor, using manufacturer's prescribed method.
5. Place and secure vise on table, truing the solid jaw.
6. Mount part.
7. Align cutters to part.
8. Make a witness cut.
9. Measure and make adjustments, as needed.
10. Finish part to specifications.
11. For deep slots, use flood coolant.
12. Set low end feed and about ½ of deep slot depth.
13. For cutoff operations, set up in solid setup.
14. For cutoff operations, cut to full depth, if possible, and make feed and speed adjustments, as needed.

DUTY H: OPERATING MILLS

22. TASK: Mill parts square

PERFORMANCE OBJECTIVE

Furnished with material, part drawing, mill and accessories, and measuring tools, square the workpiece. Part must meet specifications, and be square within a tolerance of + or - 0.001".

TOOLS AND EQUIPMENT

Mill
Table vise
Dial indicator
Soft faced hammer
Micrometers
Accessories
Shim stock
Cutter
Square

PERFORMANCE GUIDE

1. Determine part material.
2. Mount and align solid jaw of vise with indicator (+ or - 0.0001").
3. Select and mount proper cutter.
4. Mount part in vise securely and seat.
5. Make first cut.
6. Turn off machine and rotate cut face against fixed vise jaw and set and secure.
7. Make second cut, check accuracy and shim against fixed jaw, as needed.
8. Measure and turn part 180 degrees so that second cut surface is now on bottom on parallels, keep first face against fixed jaw.
9. Make third cut.
10. Roll part 90 degrees and cut last face.

DUTY H: OPERATING MILLS

23. TASK: Calculate and machinine gears

PERFORMANCE OBJECTIVE

Provided with part drawing, machinery's handbook, mill and accessories, gear blank, and precision measuring tools, mill the gear blank to drawing specifications. Allowable tolerance is - 0.000" to + 0.002".

TOOLS AND EQUIPMENT

Mill
Mandrel
Indexing head with hole plates
Drive dog
Test bar
Gear tooth vernier caliper
T-slot bolts and paper strip
Gear blank
Gear tooth cutter
Steady rest
Dial indicator
Square
Handbook

PERFORMANCE GUIDE

1. Mount and align indexing head on mill.
2. Calculate gear dimensions.
3. Calculate indexing movements. See handbook for formulas.
4. Mount hole plate on index head.
5. Press blank onto mandrel.
6. Mount mandrel and drive dog on centers (large diameter toward index head).
7. Lock movement of mandrel
8. Align cutter over centerline by touch off or square and machine dials.
9. Place center rest under blank.
10. Lock cross slide.
11. Set operating conditions.
12. Start mill and raise knee to touch paper on blank.
13. Zero dial.
14. Set scratch depth of tooth.
15. Feed with longitudinal feed.
16. Index to each tooth position and take scratch cut onto edge of blank.
17. Count number of teeth.
18. Set rough depth and cut all tooth positions.
19. Set finish depth after measurement.
20. Measure and inspect to tolerances and take a spring pass around without depth adjustment to take out tool pressure and spring.
21. Deburr and inspect.

DUTY I: OPERATING GRINDERS - SURFACE

1. TASK: Set operating conditions

PERFORMANCE OBJECTIVE

Provided with a grinder (surface, O.D., tool and cutter, I.D.), calculate and set operating conditions to operator's manual and wheel specifications.

TOOLS AND EQUIPMENT

Precision grinding machine
Operators manual
Machinery's handbook

PERFORMANCE GUIDE

1. Study operator's guide.
2. Read grinding wheel specs.
3. Determine material specs.
4. Set operating conditions.
5. Check settings.
6. Run test pass and evaluate setting, make necessary adjustments.

DUTY I: OPERATING GRINDERS - SURFACE

2. TASK: Select, change, and dress grinding wheels

PERFORMANCE OBJECTIVE

Provided with grinder, part drawing, and dressing tools, dress and true a grinding wheel. Wheel shall meet drawing specifications.

TOOLS AND EQUIPMENT

Surface grinder or (O.D. grinder,
  I.D. grinder
Tool and cutter grinder
Grinding wheel
Diamond dresser and holder
Magnetic chuck

PERFORMANCE GUIDE

1. Visually inspect and perform ring test on grinding wheel, replace cracked wheels.
2. Select and set up wheel dresser.
3. Clean magnetic chuck before placing dresser in position.
4. Position off centerline in direction of rotation of wheel.
5. Place paper under dresser and wheel.
6. Energize chuck.
7. Raise wheel above dresser.
8. Position wheel over dresser.
9. Start grinder, wear appropriate eye protection.
10. Place layout die on wheel face.
11. Lower wheel to touch dresser.
12. Feed diamond across wheel with crossfeed handle.
13. Lower wheel another 0.0005" for each pass until layout die on face is essentially gone and wheel is true.

DUTY I: OPERATING GRINDERS - SURFACE

3. TASK: Grind tools, sharpen, and recondition

PERFORMANCE OBJECTIVE

Provided with pedestal grinder, tool specifications, and handtools, grind, shape, and recondition the tools. Tolerances are three degrees on angles, and 1/64" on fractional dimensions.

TOOLS AND EQUIPMENT

Pedestal grinder
Punches
Wheel dresser
Protractor
Drills
Screwdrivers
Steel rule

PERFORMANCE GUIDE

1. Visually inspect grinding wheel and replace if damaged.
2. Dress the wheel if not true and sharp.
3. Adjust tool rest to 1/16" away from wheel.
4. Check all safety guards and equipment are in place.
5. Grind tools:
   Flat surfaces
      Hold at right angles to wheel face.
      Hold securely on rest with hand.
      Move tool across face of wheel.
      Repeat steps until tool face square.
      Finish grinding on fine grinding wheel.
   Angular surfaces
      If allowed adjust tool, rest at or near desired angle.
      Hold tool on work rest firmly with hand.
      Start grinder.
      Move tool across wheel face.
      Check angle with protractor.
      Repeat steps as needed to complete tool.
   Points
      With hand hold tool at desired angle of point.
      Point tool up against direction of wheel rotation.
      Turn tool in hand with other hand to achieve concentric point.
      Check desired point angle.
      Make corrections, as needed.

DUTY I: OPERATING GRINDERS - SURFACE

4. TASK: Sharpen carbide tools

PERFORMANCE OBJECTIVE

Provided with carbide tools, tool grinder, and silicon carbide grinding wheels and diamond finishing wheel, grind carbide tools to standards and shape needed according to operations to be performed.

TOOLS AND EQUIPMENT

Tool grinder
Carbide tools
Instruction manuals

PERFORMANCE GUIDE

1. Determine tool and tool shape.
2. Determine clearances.
3. Rough out tool on roughing wheel.
4. Set rough clearance angles with tilt table, and face angles with the protractor.
5. Secondary rough out on fine silicon carbide wheel.
6. Finish to final clearances on diamond wheel, use light pressure and brush on solvent as coolant/lubricant.
7. Check edge finish and clearances to manufacturer's recommendations.

DUTY I: OPERATING GRINDERS - SURFACE

5. TASK: Grind parallel surfaces

PERFORMANCE OBJECTIVE

Provided with part(s), part drawing, measuring instruments, surface grinder, grind part parallel on the magnetic chuck. Completed part must meet tolerance of + or - 0.0005" or meet drawing callouts.

TOOLS AND EQUIPMENT

Surface grinder
Part
Paper
Stop blocks
Hone
Magnetic chuck
Micrometer (0.0001" reading)
Wheel dresser
Handbook

PERFORMANCE GUIDE

1. Deburr and clean part, check for warp on surface plate with height gage and indicator.
2. Determine warp and add shim stock corresponding to stock warp.
3. Deburr and clean magnetic chuck with hone and wipe clean.
4. Select grinding wheel and check.
5. Dress and true wheel, if needed (if already mounted on arbor, it will not need trueing).
6. Place paper under part and stop blocks at each end, place part with cup of warp down to chuck and shim placed in appropriate spot under warp cup or a warped end.
7. Energize chuck and check holding power.
8. Set part with copper set block or lead set block, apply bluing ink.
9. Adjust table travel dogs to allow 1" run over on each end of part.
10. Set crossfeed (normally at 0.030" - 0.050").
11. Overlap wheel over part about ½ face of wheel.
12. Turn grinder power on.
13. Place paper strip between part and wheel.
14. Crank wheelhead down slowly until wheel picks up paper.
15. Move wheel off of part.
16. Zero wheelhead dial.
17. Feed head down 0.005".
18. Engage feed.
19. Grind off high spots and downfeed 0.0005" to 0.001", and repeat step 17 and continue until bluing ink is cleaned off part.
20. Remove part, clean chuck, repeat steps 5-15, and 16 to 19.
21. Inspect part as per step 1, and repeat steps needed to finish part to tolerances and size.

DUTY I: OPERATING GRINDERS - SURFACE

6. TASK: Grind parts square on the surface grinder

PERFORMANCE OBJECTIVE

Provided with machined part, part drawing, measuring tools, and grinder, grind part square on all four sides. Meet tolerance on + or - ½ minute on angularity and + or - 0.0005" on dimensions.

TOOLS AND EQUIPMENT

Surface grinder
C-clamps
Micrometer
Solid square
90 degree angle plates
Wheel dresser
Bevel protractor

PERFORMANCE GUIDE

1. Select, inspect, and install grinding wheel.
2. Dress wheel, as needed.
3. Clean chuck and place angle plate and part on chuck on paper.
4. Clamp part to angle plate.
5. Adjust table stops.
6. Touch off part, move wheel off part and down feed cut depth.
7. Start coolant.
8. Grind surface one clean.
9. Place surface one against angle plate and grind surface two, 90 degrees from surface one.
10. Roll part 180 while holding surface one against angle plate.
11. Grind surface three.
12. Turn part and grind surface four.
13. Repeat steps as necessary to complete part.
14. Deburr and inspect part.

DUTY I: OPERATING GRINDERS - SURFACE

7. TASK: Grind vertical surfaces

PERFORMANCE OBJECTIVE

Provided with part, part drawing, measuring tools, and grinding equipment, grind vertical faces on the part. Part must meet tolerances of + or - 0.0005" on vertical faces and 0.0005" on all others/ or meet drawing callouts.

TOOLS AND EQUIPMENT

Grinder
Magnetic chuck
Paper
Bluing
Indicator
Stop blocks
Micrometer
Hone

PERFORMANCE GUIDE

1. Check accuracy of back gage on magnetic chuck with indicator, if out, regrind for accuracy.
2. Place part on paper against the back gage.
3. Lightly set in place and energize chuck.
4. Indicate part against back gage.
5. Set wheel dresser on table mounted in holder at 90 degrees to wheel.
6. Relieve back side or front side of wheel leaving 1/16" lip, proceed to lightly dress lip.
7. Apply bluing to vertical face on part.
8. Set table travel dogs for 1" overrun.
9. Position grinding wheel near face to grind.
10. Turn on grinder.
11. Carefully dial part into wheel, so that wheel lightly touches bluing.
12. Engage proper feed and proper direction.
13. Grind from top of face to bottom of face without any infeed.
14. At bottom, if there is a surface, touch the bluing only.
15. Move wheel to top of part.
16. Dial part into wheel 0.0005" and repeat steps 12 to 15, repeat infeed and steps 12 to 15, until part cleans up and meets part dimensions and tolerances.
17. Remove burrs and measure part.

DUTY I: OPERATING GRINDERS - SURFACE

8. TASK: Grind angles and radii on surface grinders

PERFORMANCE OBJECTIVE

Provided with part, drawing, grinding equipment, grind an angle and radius on the part. The angle and radius must meet tolerance of 0.001" and/or drawing specifications.

TOOLS AND EQUIPMENT

Grinder
Radius and angle dresser
Grinding wheel
Radius gage
Magnetic chuck
Stop blocks
Diamond dresser
Micrometer

PERFORMANCE GUIDE

1. Determine radius and angle from drawing.
2. Clean magnetic chuck and align radius dresser.
3. Set stops on the dresser for radius length.
4. Move table placing diamond under wheel and lock.
5. Rotate dresser at least ¼ turn at right angle to wheel.
6. Start grinder.
7. Move saddle until wheel touches diamond and lock.
8. Lower wheel and rotate dresser in 90 degree arc until diamond touches wheel.
9. Feed wheel down 0.002" for each rotation of radius dresser.
10. Continue until radius is complete.

Angle:

11. Either change wheel or dress radius off wheel.
12. Loosen lock on swivel ring on dresser.
13. Adjust the two swivel stop pins until the desired angle is read on the vernier plate.
14. Tighten swivel ring.
15. Turn on power and move wheel into dresser 0.002".
16. Feed diamond across face of wheel with angle traverse control handle.
17. Continue cuts of 0.002" until desired angle on wheel exists.

DUTY I: OPERATING GRINDERS - SURFACE

9. TASK: Cutoff parts

PERFORMANCE OBJECTIVE

Provided with part, drawing, and grinder, cutoff the part. Part must meet tolerance of 1/64" on fractions and/or 0.005" on decimals or drawing callouts.

TOOLS AND EQUIPMENT

Grinder
Vise
Reinforced abrasive cutoff wheel
Micrometer
Magnetic chuck
Diamond dresser
Calipers
Square

PERFORMANCE GUIDE

1. Determine part material.
2. Select cutoff wheel (size, grade, and thickness).
3. Mount grinding wheel on spindle, use paper spacer, and replace guard.
4. Place vise on chuck and align, and energize chuck.
5. Place part in vise with clearance for the wheel guard.
6. Position wheel in location of cutoff.
7. Adjust wheel head so it clears top of part.
8. Lock table position, if possible, at saddle lock.
9. Place board or nonferrous metal under cutoff area.
10. Put on eye safety protection.
11. Start grinder and table traverse while feeding wheel head down.
12. Check witness cut for size.
13. Continue cut until part is cut and measure for tolerance.

DUTY I: OPERATING GRINDERS - SURFACE

10. TASK: Plan sequence of operations

PERFORMANCE OBJECTIVE

Provided with part drawing, select grinder to use, and plan a sequence of operations to grind the part. Operations must take into account pre-machining and post-machining or assembly.

TOOLS AND EQUIPMENT

Part drawings
Assembly list

PERFORMANCE GUIDE

1. Study part drawing for needed grinding and finishes.
2. Select tooling and grinders.
3. Recommend wheel selection.
4. Determine part holding method.
5. Highlight finish requirements.
6. Check operations for inconsistency.

DUTY J: OPERATING GRINDERS I.D.

1. TASK: Grind inside diameters on I.D. grinder

PERFORMANCE OBJECTIVE

Provided with part, part drawing, measuring tools, and grinding machine and accessories, grind internal diameter of part. Part must meet tolerance of + or - 0.0005"/or drawing specifications.

TOOLS AND EQUIPMENT

I.D. grinder or tool and cutter grinder with internal grinding attachment
Measuring tools
(Other accessories, as needed, to convert tool and cutter grinder to I.D. grinder)
Grinding wheel
Dial indicator
Three-jaw universal chuck
Machinist handbook

PERFORMANCE GUIDE

1. If using tool and cutter grinder:

   Remove guards; align head parallel to table; mount wheel (2/3 to 3/4 hole size); set operating conditions; place drive belt over pulleys; mount motorized head on worktable; set up tail stock, as needed; mount three jaw on motorized head; remove tailstock

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   Place part in three jaw and dial in; adjust wheelhead to center height; start grinding; set table stops for 1/3 wheel overlap at ends of hole, if through hole; use light cuts, 0.0005" repeat until complete, checking for bell mouthed hole or taper grind.
2. For I.D. grinder, follow same steps in grinding process except skip the setup of accessories for the tool and cutter grinder.

DUTY J: OPERATING GRINDERS I.D.

2. TASK: Grind to shoulder

PERFORMANCE OBJECTIVE

Provided with part, part drawing, grinder, and measuring tools, grind I.D. to a shoulder (blind or counterbore). Part must meet drawing tolerances or +/- 0.001".

TOOLS AND EQUIPMENT

I.D. grinder
Measuring tools
Wheel dresser
Machinist handbook

PERFORMANCE GUIDE

1. Select and inspect grinding wheel, setup, and dress wheel.
2. Place part in three jaw chuk and indicate true.
3. Set operating conditions for part material and wheel.
4. Wear eye protection and safety guards in practice.
5. Set depth stops 0.010" short of finish shoulder depth.
6. Grind I.D., being careful not to crash shoulder, but to grind shoulder.
7. Within 0.005" of diameter or so, back depth stop 0.0005" to 0.001" and grind back shoulder.
8. Continue steps until shoulder is within 0.001" of finish and so is the I.D.
9. Deburr and inspect part.

DUTY J: OPERATING GRINDERS I.D.

3. TASK: Grind a taper

PERFORMANCE OBJECTIVE

Provided with part, drawing, and grinder, set taper and grind taper on part. Part must meet drawing tolerances.

TOOLS AND EQUIPMENT

I.D. grinder	Measuring tools
Bevel protractor	Dial indicator
Handbook	Grinding wheel
Bluing	

PERFORMANCE GUIDE

1. Select and inspect grinding wheel, and set up in grinder.
2. Mount part in three jaw and indicate true.
3. Set grinder table to desired taper and indicate.
4. Apply bluing inside part I.D.
5. Set operating conditions for material and wheel.
6. Touch off large end of taper and zero dials.
7. Set travel stops.
8. Wear eye protection and all guards in place.
9. Grind at depths of 0.001" to 0.003" until part roughed out.
10. Check taper.
11. Re-dress wheel or install finish wheel.
12. Bluing taper.
13. Touch off ink and in feed 0.0005".
14. Finish grind, checking tolerance along the way.
15. Deburr and inspect part.

DUTY J: OPERATING GRINDERS I.D.

4. TASK: Grind internal radius

PERFORMANCE OBJECTIVE

Provided with grinder, drawing and part, measuring tools, set up and grind radius. Part must meet drawing callouts and tolerances.

TOOLS AND EQUIPMENT

I.D. grinder
Measuring tools
Grinding wheel
Handbook

PERFORMANCE GUIDE

1. Select, inspect, and set up wheel, true and dress.
2. Safety clause.
3. Set radius dresser and dress radii on wheel edge or face.
4. Mount part in machine and indicate true.
5. Locate position of radius in part.
6. Set operating conditions.
7. Set stops.
8. Touch off part and zero dials.
9. Traverse wheel into part from side if application calls for it, or feed from inside of bore into shoulder or part where radius is located.
10. Check part dimensions.
11. Re-dress radius and wheel as needed to complete part.
12. Deburr and inspect part.

DUTY J: OPERATING GRINDERS I.D.

5. TASK: Grind recess

PERFORMANCE OBJECTIVE

Provided with part, drawing, and grinder, locate and grind recess in part. Part must meet drawing tolerances or +/- 0.001".

TOOLS AND EQUIPMENT

Grinder
Grinding wheel
Measuring tools
Handbook
Steel ink
Indicator

PERFORMANCE GUIDE

1. Select, inspect, and set up grinding wheel.
2. Mount part and indicate true.
3. Set operating conditions.
4. Locate wheel over recess in part.
5. Set stops.
6. Safety clause.
7. Start grinder.
8. Pick up I.D. of recess.
9. Zero dials.
10. Feed in 0.0005" and grind.
11. Continue process, frequently checking part dimensions and tolerances.
12. Deburr and inspect.

DUTY J: OPERATING GRINDERS I.D.

6. TASK: Grind internal angle

PERFORMANCE OBJECTIVE

Provided with part drawing, part, measuring tools, grinder and accessories, grind angle on internal face. Part must meet drawing specifications.

TOOLS AND EQUIPMENT

Grinder
Angle dresser
Measuring tools
Three jaw universal chuck
Grinding wheel
Diamond dresser
Handbook

PERFORMANCE GUIDE

1. Select wheel and setup, and dress and true.
2. Safety clause.
3. Set up angle dresser and adjust for desired angle by loosening ring clamp and moving arm, reclamp ring.
4. Mount dresser in proper relation to wheel.
5. Move dresser to contact wheel, and slide arm up away for edge.
6. Lock table.
7. Turn on grinder.
8. Traverse diamond points past edge of wheel with dresser arm, moving in crossfeed 0.001" each pass.
9. Continue to dress, until angle is desired width.
10. Remove dresser.
11. Locate wheel near face to be ground.
12. Start grinder.
13. Touch off face and set dials at zero.
14. Slowly move wheel into face at infeeds of 0.0005" and let grinder spark out.
15. Deburr and inspect part.

DUTY J: OPERATING GRINDERS I.D.

7. TASK: Set Operating Conditions

PERFORMANCE OBJECTIVE

Provided with a work part, grinder, manual, part print, measuring/inspection tools. Set operating conditions for internal grinding.

2) TOOLS AND EQUIPMENT

Grinder
Work part
Grinding manual
Handbook
Internal grinding guidelines

PERFORMANCE GUIDE

1. Determine needed operations of part to be ground.
2. Determine cutter and work part material.
3. Set operating conditions on grinder speed, feed, DOC, rotation, fluids.
4. Mount the work part securly to insure finished part accuracy.
5. Measure and inspect finished hole for accuracy to part print.
6. Check proper application of all safety devices and equipment.

DUTY J: OPERATING GRINDERS I.D.

8. TASK: Plan of sequence of operations

PERFORMANCE OBJECTIVE

Given a part drawing, plan the sequences of operation to perform the internal grinding operation as required.

TOOLS AND EQUIPMENT

Part print
Grinder
Wheel
Cutting fluids
Measuring/inspection tools
Handbook
Internal grinding guidelines

PERFORMANCE GUIDE

1. Review drawing.
2. Sequence operations.
3. Productivity factors.
4. Safety factors.
5. Removing burrs, measuring/inspection of part.
6. Review the sequence plan.
7. Record on operations form.

DUTY K: OPERATING GRINDERS O.D.

1. TASK: Align grinder head, table, and footstock

PERFORMANCE OBJECTIVE

Provided with grinder, alignment bar, and indicator, align the O.D. grinder to grind parallel to within 0.0001" or less deviation.

TOOLS AND EQUIPMENT

Grinder
Alignment bar
Dial indicator
Wrenches

PERFORMANCE GUIDE

1. Clean centers on grinder head and footstock.
2. Clean center holes in alignment bar.
3. Mount bar between centers.
4. Mount indicator on wheel head.
5. Check alignment marks on ends of table and/or head.
6. Break loose clamp bolts.
7. Contact alignment bar at one end of bar with indicator and infeed 0.020" and zero dial.
8. Traverse table so that indicator moves to opposite end of bar.
9. Note deviations in reading from one end to next.
10. Adjust table or head accordingly.
11. Snug clamp bolts.
12. Indicate bar again.
13. Repeat steps as needed to align grinder.

DUTY K: OPERATING GRINDERS O.D.

2. TASK: Grind outside diameters

PERFORMANCE OBJECTIVE

Provided with part, part drawing, measuring tools, and grinding equipment, grind diameter of part. Part must meet drawing specifications and/or +/- 0.0005" tolerance.

TOOLS AND EQUIPMENT

Cylindrical grinder
Grinding wheel
Dial indicator
Micrometer
Drive dog
Machinery's handbook
Dresser
Test alignment bar
High pressure lubricant

PERFORMANCE GUIDE

1. Check condition of centers and clean or replace.
2. Clean test bar center holes.
3. Align grinder with test bar and indicator.
4. Dress and true grinding wheel.
5. Apply high pressure lubricant to center holes in part.
6. Place drive dog on part.
7. Place part between centers.
8. Safety clause.
9. Start grinder, and run to warm bearings and get coolant to flow.
10. Adjust table traverse for about 1/3 wheel runoff at each end of part.
11. Set operating conditions per material.
12. Set part rotation to CCW.
13. Set feed mechanism.
14. Start table traverse.
15. Touch off part and zero dial.
16. Grind part to surface cleanup.
17. Check dimensions and calculate stock left to grind.
18. Set cut depth and grind until part to size.
19. Deburr and inspect the part.

DUTY K: OPERATING GRINDERS O.D.

3. TASK: Grind to shoulder

PERFORMANCE OBJECTIVE

Provided with part, drawing, measuring tools, and grinder and attachments, set up and grind to a shoulder on the part. Part must meet specifications to size, tolerance, and finish.

TOOLS AND EQUIPMENT

Grinder
Micrometer
Vernier caliper or depth mic
Grinding wheel
Handbook

PERFORMANCE GUIDE

1. Safety clause.
2. Check alignment of grinder.
3. Inspect and dress grinding wheel.
4. Clean part center holes if to be done between centers.
5. Mount part in chuck or on centers.
6. Set operating conditions.
7. Set stops 0.005" short of shoulder.
8. Apply bluing to shoulder.
9. Turn on grinder and pick up part diameter.
10. Grind O.D. stopping at stop short of shoulder.
11. After part is to diameter, set travel indicator up and back off stop to shoulder and pick up bluing.
12. Traverse wheel out away from shoulder.
13. Check tolerances.
14. Deburr and inspect.

DUTY K: OPERATING GRINDERS O.D.

4. TASK: Grind taper

PERFORMANCE OBJECTIVE

Provided with part, drawing, measuring tools, and grinder, set up and grind taper to drawing tolerances.

TOOLS AND EQUIPMENT

Grinder
Indicator
Handbook
Wrenches
Measuring tools
Alignment bar
Bluing
Drive dog

PERFORMANCE GUIDE

1. Check and clean centers and center holes on part.
2. Determine taper from drawing.
3. Set taper on grinder by gage.
4. Install alignment bar and indicate desired taper.
5. Apply high pressure lubricant to part center holes.
6. Install part in grinder, with drive dog installed on part.
7. Set center pressure.
8. Set operating conditions.
9. Safety clause.
10. Turn on grinder.
11. Touch off part at large end of taper.
12. Zero dial.
13. Infeed about 0.002" for roughing or until part cleans up.
14. Check taper obtaining on part and make desired adjustments.
15. Finish grind part, 0.0005" depth per pass.
16. Allow grinder to spark out.
17. Deburr and measure part for size and tolerance.

DUTY K: OPERATING GRINDERS O.D.

5. TASK: Grind radius

PERFORMANCE OBJECTIVE

Provided with part, drawing, grinder with accessories, grind radius on part to meet drawing dimensions.

TOOLS AND EQUIPMENT

Grinder
Wheel dresser
Radius gage
Measuring tools
Handbook

PERFORMANCE GUIDE

1. Safety clause.
2. Set up radius dresser.
3. Inspect and dress desired radii on wheel.
4. Check radii against radius gage.
5. Mount part in grinder
6. Align part, as needed.
7. Set operating conditions.
8. Position wheel over location of radius.
9. Apply bluing to part at blend.
10. Pick up diameter and zero dial.
11. Back out and apply to blend area again.
12. Position over location.
13. Plunge to blend diameter at a rate of 0.001" each infeed, until the ink at the blend diameter is touched for reference zero.
14. Let wheel spark out for finish and dimension.
15. Deburr and check radius with gage.

DUTY K: OPERATING GRINDERS O.D.

6. TASK: Grind angle

PERFORMANCE OBJECTIVE

Provided with part, drawing, grinder and accessories, and measuring tools, set up and grind an angle on the part. Part must meet part drawing tolerances.

TOOLS AND EQUIPMENT

Grinder
Wheel dresser
Bevel protractor
Bluing
Handbook

PERFORMANCE GUIDE

1. Safety clause.
2. Set up dresser on grinder, inspect, dress and true wheel, as needed.
3. Determine angle to be dressed from drawing.
4. If possible, set part at angle; if not possible, dress angle on wheel.
5. Apply bluing to area to receive angle to make it easier to see grind.
6. Set up operating conditions.
7. Position wheel over location of angle.
8. Plunge grind angle.
9. Spark out wheel at end of grind.
10. Measure angle with bevel protractor.

DUTY K: OPERATING GRINDERS O.D.

7. TASK: Plunge grind O.D.

PERFORMANCE OBJECTIVE

Provided with part, drawing, measuring tools, and grinder, set up and plunge grind diameter on part. Part must meet drawing specifications.

TOOLS AND EQUIPMENT

Grinder
Micrometer
Handbook
Alignment bar

Wheel dresser
Steady rest
Dial indicator

PERFORMANCE GUIDE

1. Check alignment of table travel with alignment bar and indicator.
2. Set operating conditions.
3. Safety clause.
4. Inspect and dress wheel.
5. Check diameter to plunge grind.
6. Set up steady rest directly behind part, in line with wheel, if part not held in chuck.
7. Locate wheel over area to grind.
8. Set stops.
9. Set dial indicator against part to measure deflection.
10. Turn on grinder.
11. Plunge wheel into part 0.0005" to 0.001" at a time and allow wheel to spark out between each infeed.
12. Stop process several times and check dimensions and recalculate infeed.
13. Continue process until part is finished.
14. Deburr and inspect part.

DUTY K: OPERATING GRINDERS O.D.

8. TASK: Set Operating Conditions

PERFORMANCE OBJECTIVE

Provided with a part to grind, grinder, manual, part print, measuring/inspection tools perform the outside grinding operation as required.

TOOLS AND EQUIPMENT

Grinder
Work part
Grinding manual
Handbook
External grinding guidelines

PERFORMANCE GUIDE

1. Determine needed operations of part to be ground.
2. Determine cutter and work part material.
3. Set operating conditions on grinder speed, feed, DOC, rotation, fluids.
4. Mount the work part securly to insure finished part accuracy.
5. Measure and inspect finished hole for accuracy to part print.
6. Check proper application of all safety devices and equipment.

DUTY K: OPERATING GRINDERS O.D.

9. TASK: Plan of sequence of operations

PERFORMANCE OBJECTIVE

Given a part drawing, plan the sequences of operation to perform the external grinding operation as required.

TOOLS AND EQUIPMENT

Part print
Grinder
Wheel
Cutting fluids
Measuring/inspection tools
Handbook
External grinding guidelines

PERFORMANCE GUIDE

1. Review drawing.
2. Sequence operations.
3. Productivity factors.
4. Safety factors.
5. Removing burrs, measuring/inspection of part.
6. Review the sequence plan.
7. Record on operations form.

DUTY L: OPERATING GRINDERS/TOOL

1. TASK: Set operating conditions

PERFORMANCE OBJECTIVE

Provided with cutter to grind, grinder and tool grinding manual, set operating conditions for tool grinding operation.

TOOLS AND EQUIPMENT

Grinder
Identified cutter
Tool grinding manuals
Handbook

PERFORMANCE GUIDE

1. Determine needed operations on cutter needing grinding.
2. Determine cutter material and wheel type.
3. Set operating conditions on grinder: RPM, feed, rotation, angles.
4. Check proper placement of safety devices.

DUTY L: OPERATING GRINDERS/TOOL

2. TASK: Grind end mills

PERFORMANCE OBJECTIVE

Furnished with end mill, grinding machine, tool specifications, sharpen the cutter. Cutter must meet specs and a tolerance of +/- 0.001" on decimals and +/- 1 degree on angular dimensions.

TOOLS AND EQUIPMENT

Tool and cutter grinder
Stick dresser
Tooth rest
Wrenches
Handbook
End mill adaptors
Wheel dresser
Micrometer
Cup flaring wheel
Cutter gage
Square

PERFORMANCE GUIDE

1. Inspect and install proper cup wheel.
2. True and dress with stick dresser to narrow face of 1/8" to 3/16".
3. Set work head square with table and then rotate two degrees to three degrees CCW.
4. Set axial relief angle five degrees and lock head.
5. Attach flicker tooth rest with micrometer adjustment so downward grinding pressure is against the rest.
6. Install end mill with adaptor.
7. Traverse end mill to locate center across edge of wheel flicker.
8. Set stops.
9. Safety clause.
10. Start and run spindle to warm bearings.
11. Infeed cutter 0.003" and traverse across face of wheel.
12. Ratchet and grind next tooth.
13. Continue steps until damage removed and cutter is sharp.
14. Raise work head spindle and grind secondary clearance 2 x axial relief angle; adjust spindle height to match.
15. Deburr, hone, and inspect cutter.

DUTY L: OPERATING GRINDERS/TOOL

3. TASK: Grind helical cutters

PERFORMANCE OBJECTIVE

Furnished with grinder, specifications, and milling cutter, sharpen the cutter. Cutter must meet tolerance of +/- 1 degree and +/- 0.001".

TOOLS AND EQUIPMENT

Grinder
Indicator
Offset toothrest
Dog or clamp
Micrometer
Cutter
Centering gage
Test Bar
Flare cup wheel
Mandrel
Cutter clearance gage
Wrenches
Stick dresser
Chalk

PERFORMANCE GUIDE

1. Select, inspect proper wheel.
2. Clean grinder table and position tailstock center for mandrel.
3. Align upper table with test bar and indicator.
4. Swivel wheel so spindle revolves CCW.
5. Mount wheel and set operating conditions.
6. True wheel face, and dress 30 degree chamfer inside to a 1/16" wheelface.
7. Swivel wheelhead 89 degrees and lock.
8. Center head to centering gage and lock.
9. Position toothrest.
10. Apply chalk to top of toothrest.
11. Mount cutter on mandrel between centers.
12. Move table toward wheel until cutter toothrests on toothrest.
13. Center toothrest.
14. Adjust table toward grinding wheel and position cutter tooth on top of toothrest.
15. Set cutter clearance dial to zero.
16. Lower wheelhead desired clearance.
17. Set table stops.
18. Safety clause.
19. Feed table until cutter touches wheel.
20. Feed cutter into wheel 0.001".
21. Traverse table and hold cutter against toothrest.
22. Set rotation to go down against rest.
23. Grind full length and return to start.
24. Move table to clear cutter of wheel.
25. Rotate cutter ½ turn.
26. Grind next tooth.
27. Measure for taper.
28. Grind remaining teeth, if land is over 1/16", grind secondary clearance.
29. Deburr, hone, and inspect part.

DUTY L: OPERATING GRINDERS/TOOL

4. TASK: Grind angular cutters

PERFORMANCE OBJECTIVE

Provided with milling cutter, grinder, and cutter specs, sharpen the cutter. The cutter should meet cutter specifications.

TOOLS AND EQUIPMENT

Tool and cutter grinder
Dial indicator
Toothrest
Cutter clearance gage
Handbook
Bevel protractor
Milling cutter
Arbor
Grinding wheel
Center gage
Wheel dresser

PERFORMANCE GUIDE

1. Select, inspect, mount, and dress wheel.
2. Mount tailstock.
3. Indicate arbor for runout.
4. Mount toothrest on wheelhead.
5. Adjust wheelhead and toothrest to height with center gage.
6. Adjust table to desired angle.
7. Mount cutter in grinder.
8. Recheck and reset tooth height.
9. Set evaluation handwheel to zero.
10. Calculate wheel adjustment for clearance.
11. Lower head required amount.
12. Safety clause--Clear cutter form wheel.
13. Rotation clause (down against tooth rest)--Start grinder.
14. Traverse cutter across wheel face.
15. Add infeed in small amounts.
16. Grind opposite tooth.
17. Check dimensions and grind remaining teeth.
18. Deburr, hone, and inspect part.

DUTY L: OPERATING GRINDERS/TOOL

5. TASK: Grind step drills

PERFORMANCE OBJECTIVE

Provided with drill, specifications for hole, and grinder with accessories, grind the drill into a step drill. The cutter must be concentric within 0.0005".

TOOLS AND EQUIPMENT

Drill
Tool and cutter grinder
Micrometer
Drawing
Steel ink

PERFORMANCE GUIDE

1. Select drill to be ground.
2. Select grinding wheel.
3. Set up collet assembly in headstock.
4. Dress and true grinding wheel.
5. Lay out length of step on drill.
6. Tilt head if drill to be tapered step drill.
7. Touch off drill and zero dial.
8. Set table stops.
9. Feed in 0.001" for roughing cuts.
10. Grind drill, stop and measure drill for size.
11. Continue until drill is desired size.
12. Inspect for clearance.
13. Set up and grind secondary clearance on drill behind cutting lip, create a land.
14. Inspect drill for size and clearance.

DUTY L: OPERATING GRINDERS/TOOL

6. TASK: Grind reamers

PERFORMANCE OBJECTIVE

Provided with dull reamer, specifications, and grinder with attachments, resharpen reamer. Reamer must meet tool specifications, or drawing specs.

TOOLS AND EQUIPMENT

Tool and cutter grinder
Toothrest
Micrometer
Diamond dresser
Reamers
Hone
Flare cup wheel
Stick dresser

PERFORMANCE GUIDE

1. Set up grinding wheel, dress and true.
2. Set reamer between centers.
3. Mount toothrest and adjust to center height.
4. Adjust wheelhead to relief angle on reamer.
5. Adjust table stops to allow enough travel to grind relief and not touch center in footstock.
6. Place one tooth on toothrest and bring wheel in contact with tooth.
7. Infeed 0.0005" and grind each tooth of the reamer.
8. Infeed 0.0005" and grind around again until all teeth clean up.
9. Calculate secondary offset of wheelhead and adjust up.
10. Apply steel ink to edges.
11. Infeed 0.0005" and grind around.
12. Leave a land of about 0.012".

DUTY L: OPERATING GRINDERS/TOOL

7. TASK: Sharpen taps

PERFORMANCE OBJECTIVE

Provided with dull tap, grinder, and tool specifications, set up and sharpen tap. Tap clearances must meet specifications.

TOOLS AND EQUIPMENT

Tap
Dish grinding wheel
Steel ink

Grinder
Toothrest with micrometer dial

PERFORMANCE GUIDE

1. Rotate wheelhead 90 degrees up.
2. Mount dish wheel and dress with stick dresser.
3. Place tap between centers with cutting lip facing down.
4. Install toothrest and adjust to center by eye, place on opposite side of tap as wheel.
5. Calculate clearance.
6. Set toothrest with center gage.
7. Dial toothrest down calculated amount for clearance.
8. Apply steel ink to lip.
9. Set travel stops.
10. Start grinder.
11. Touch off tap.
12. Move wheel head up 0.001" and traverse length of tap, index tap, and do all flutes.
13. Move wheelhead up again and continue until tap is finished.

DUTY L: OPERATING GRINDERS/TOOL

8. TASK: Grind assorted cutters and tools

PERFORMANCE OBJECTIVE

Furnished with cutting tools (thread chasers, boring bars, turning tools, carbide tools), look up clearances and techniques and grind tool to desired specifications and/or drawing callouts.

TOOLS AND EQUIPMENT

Assorted tools
Grinding wheels
Measuring tools
Clearance gages
Stick dresser
Tool grinder
Carbide wheel
Protractor
Wheel dresser

PERFORMANCE GUIDE

1. Select grinding wheel for tool and clearances needed.
2. Set up wheel, and dress and true.
3. Mount tool if needed in vise, clamped to table, or held freehand, set clearances by tilting wheelhead or tilting tool in angle vise or sine plate.
4. Grind, slit, or cutoff tool, as needed.
5. Finish grinding any secondary clearances.

DUTY L: OPERATING GRINDERS/TOOL

9. TASK: Grind form tools

PERFORMANCE OBJECTIVE

Provided with tool blank, grind form tool. Tool must meet drawing specifications.

TOOLS AND EQUIPMENT

Tool blank
Layout tools
Micrometers
Grinder
Steel ink
Dial calipers

PERFORMANCE GUIDE

1. Lay out tool form as best you can.
2. Set up holding device.
3. Select grinding wheel, and dress and true.
4. Form dress grinding wheel, as needed.
5. Set operating conditions.
6. Set clearance angles with angle vise or other means.
7. Grind tool in stages.
8. Grind secondary clearances, as needed.
9. Inspect and measure tool.

DUTY L: OPERATING GRINDERS/TOOL

10. TASK: Identify and correct grinder problems.

PERFORMANCE OBJECTIVE

Grinder, and tool grinding operations. When problems occur, identify source and correct problem to achieve acceptable grinding results.

TOOLS AND EQUIPMENT

Grinder

PERFORMANCE GUIDE

1. Watch for poor finish.
2. Listen for chatter or looseness in setup.
3. Determine course of action.
4. Correct problem.

DUTY L: OPERATING GRINDERS/TOOL

11. TASK: Plan sequence of operations.

PERFORMANCE OBJECTIVE

Furnished with part drawings, plan a sequence of operations to grind a milling cutter to print specs.

TOOLS AND EQUIPMENT

Tool and cutter grinder
Part print
Cutting tool to grind
Grinding wheel
Grinding fluid
Work holding device

PERFORMANCE GUIDE

1. Review part print.
2. Sequence operations.
3. Productivity.
4. Safety.
5. Work and tool mounting.
6. Review sequence part finishing and inspection/measure.
7. Record on operators form.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

1. TASK: Machining electrodes

PERFORMANCE OBJECTIVE

Provided with electrode material (i.e., copper, graphite), part drawing, and machine tools, machine electrode to tolerances allowable and/or 0.0001".

TOOLS AND EQUIPMENT

Lathe
Mill
Grinder
Saw
Cutting tools

PERFORMANCE GUIDE

1. Study drawing for contour and shape of detail to be machined by EDM.
2. Select electrode by EDM machine demands.
3. Select machining process to make electrode.
4. Machine electrode to shape and size.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

2. TASK: Mount electrode in holder

PERFORMANCE OBJECTIVE

Provided with electrode, electrode holder, and handtools, mount the electrode in the holder ready for EDM process. Must be aligned within 0.0001".

TOOLS AND EQUIPMENT

Allen wrenches
Electrode
Surface plate
Electrode holder
Indicator

PERFORMANCE GUIDE

1. Clean electrode holder.
2. Place electrode in holder and snug allen screws.
3. Check alignment with indicator.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

3. TASK: Position workpiece

PERFORMANCE OBJECTIVE

Furnished with part, holding devices, EDM, and indicators, position and clamp part in machine. Part must be aligned within 0.0001".

TOOLS AND EQUIPMENT

EDM
Vise or clamps
Indicator
Wrenches

PERFORMANCE GUIDE

1. Determine flushing method.
2. Determine best method to hold part.
3. Select vise or clamps or fixture.
4. Clean work surface on machine.
5. Place holding device on work surface.
6. Snug holding device.
7. Indicate fixed surface of device.
8. Place part in or on holding device.
9. Secure part.
10. Indicate part, if needed.
11. Locate reference zero.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

4. TASK: Align work and check clearances

PERFORMANCE OBJECTIVE

Provided with part and setup Electrical Discharge Machine and indicators, align part and check clearances between machine and part. Part must be aligned within 0.0001".

TOOLS AND EQUIPMENT

EDM
Dial indicator
Wrenches

PERFORMANCE GUIDE

1. Place part in work space in a vise, fixture, or clamped directly to table.
2. Indicate part and align part, or work to reference hole or mark, preexisting form layout or prior machining.
3. Double check alignment.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

5. TASK: Set operating conditions

PERFORMANCE OBJECTIVE

Provided with part and EDM, set up machine to do job in effective and safe manner.

TOOLS AND EQUIPMENT

Material
Guidebooks

PERFORMANCE GUIDE

1. Determine material and machine technology.
2. Set depth of cut.
3. Select electrical discharge circuit.
4. Select best method for flushing with the dielectric fluid and make adjustments.
5. Check setup.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

6. TASK: Perform internal cuts (burns)

PERFORMANCE OBJECTIVE

Provided with electrode, part drawing, and setup accessories, EDM an internal contour. Part must meet drawing specifications.

TOOLS AND EQUIPMENT

EDM and accessories
Measuring tools

PERFORMANCE GUIDE

1. Set up holding device and align.
2. Set up electrode and check alignment.
3. Set operating conditions for rough burn.
4. Flood part zone with dielectric.
5. Tough off part, zero gages.
6. Begin burn, checking for correct burn reactions.
7. Retract head.
8. Install finish electrode if operation calls for it.
9. Check part tolerance, and finish.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

7. TASK: Perform external cuts

PERFORMANCE OBJECTIVE

Furnished with drawing, electrode, and EDM, burn external contour. Part must meet drawing specs and tolerances.

TOOLS AND EQUIPMENT

EDM
Electrode and holder
Measuring tools
Indicator

PERFORMANCE GUIDE

1. Set up electrode and holder.
2. Place and align part.
3. Set operating conditions: depth of cut, electrical charge, flushing method.
4. Align electrode over burn.
5. Flood parat zone.
6. Zero dials.
7. Begin burn and check process for correct machine reactions during burn.
8. Retract.
9. Check part dimensions and finish.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

8. TASK: Perform repair work

PERFORMANCE OBJECTIVE

Provided with EDM, and part in need of repair, EDM out broken tool. Maintain part integrity as per drawing specifications.

TOOLS AND EQUIPMENT

EDM
Electrode
Indicator
Clamps
Measuring tools

PERFORMANCE GUIDE

1. Determine best setup method.
2. Machine electrode to specs.
3. Set up and align part.
4. Locate area to burn.
5. Locate reference zero.
6. Flood part zone.
7. Burn part.
8. Check part and continue, as needed.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

9. TASK: Identify and solve machine problems

PERFORMANCE OBJECTIVE

Furnished with EDM and machine technology, identify problems, and solve problems for accurate part burn.

TOOLS AND EQUIPMENT

EDM
Tooling
Part

PERFORMANCE GUIDE

1. Observe operation of burn.
2. Make adjustments in depth, electrical charge, and flushing to correct problems and electrode wear.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

10. TASK: Perform basic maintenance

PERFORMANCE OBJECTIVE

Furnished with an EDM, and during the course of operating the EDM, perform basic maintenance as per operator's manual.

TOOLS AND EQUIPMENT

Basic handtools
Bucket
Rags

PERFORMANCE GUIDE

1. Inspect machine for wear and looseness.
2. Adjust gibs.
3. Blow out capacitors if older machine.
4. Drain dielectric and replace.
5. Clean or replace filters.
6. Clean workspace of swarth.
7. Properly dispose of dielectric in an approved manner.

DUTY M: OPERATING EDM (ELECTRICAL DISCHARGE MACHINES)

11. TASK: Plan sequence of operations

PERFORMANCE OBJECTIVE

Furnished with drawing, study and plan sequence of operations to accurately complete burn.

TOOLS AND EQUIPMENT

Drawing
Manuals

PERFORMANCE GUIDE

1. Study drawing for part detail.
2. Select electrode size and shape.
3. Sequence operations.
4. Check sequence.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

1. TASK: Test hardness of metal

PERFORMANCE OBJECTIVE

Provided with part, Rockwell hardness tester and charts, set up and test the hardness. Results should be repeatable.

TOOLS AND EQUIPMENT

Material
Rockwell tester
Charts

PERFORMANCE GUIDE

1. Determine hardness requirement from drawing.
2. Open throat of hardness tester, with handwheel at bottom of adjusting screw.
3. Select anvil to install in tester.
4. Cover diamond indenter with finger of one hand.
5. Place anvil in bore provided in top of screw.
6. Wipe anvil and part clean.
7. Cover diamond with finger again.
8. Place part on anvil, always holding with one hand.
9. Raise anvil, using hand wheel, until the part touches the diamond indenter.
10. Apply preload.
11. Zero dial.
12. Apply secondary load, and release load when indicator needle stops.
13. Read hardness number off of dial and record.
14. Release preload.
15. Move part so diamond is located over different area.
16. Repeat steps nine through 14 and record results.
17. If required, use charts to determine equivalent hardness or tensile strength.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

2. TASK: Perform nondestructive testing

PERFORMANCE OBJECTIVE

Provided with heat treated part and dye penetrant materials, examine the part for cracks. Results should be repeatable and reliable at identifying cracks.

TOOLS AND EQUIPMENT

Heat treated part
Dye penetrant materials
Rags or paper towels
Gloves

PERFORMANCE GUIDE

1. Determine those surfaces of part that require inspection.
2. Clean surfaces of part with solvent and then dry.
3. Apply dye penetrant to part per manufacturer's directions.
4. Remove excess penetrant with rags or paper towels and solvent.
5. Apply developer to part per manufacturer's directions.
6. Visually examine part for crack indications.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

3. TASK: Perform destructive testing

PERFORMANCE OBJECTIVE

Provided with test samples that have been heat treated along with the parts, perform tensile tests. Results should be repeatable.

TOOLS AND EQUIPMENT

Tensile test samples
Universal test machine
Sample grips
Caliper

PERFORMANCE GUIDE

1. Determine tensile strength requirement from drawing.
2. Insert appropriate grips into crossheads of machine.
3. Measure diameter of tensile test sample using caliper.
4. Calculate area of cross-section and record.
5. Insert tensile test sample into grips and remove slack.
6. Zero load indicator on test machine.
7. Apply load to test sample at a controlled rate until failure occurs.
8. Record load indicator reading.
9. Calculate tensile strength from cross-section area and load at failure.
10. Remove broken test sample from grips.
11. Repeat steps 3 through 10 for other samples.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

4. TASK: Harden metals

PERFORMANCE OBJECTIVE

Provided with heat treatment equipment, part, drawing, and references, harden the part. The part must meet drawing specifications and a tolerance of +/- 2 on Rockwell C scale.

TOOLS AND EQUIPMENT

Heat treat furnace
Face shield
Steel manufacturer's handbook
Part
Quench bath
Rockwell tester
Gloves

PERFORMANCE GUIDE

1. Determine material and thickness.
2. Look up hardening temperature for material.
3. Set furnace temperature.
4. Place part in oven and start oven or preheat oven as per manufacturer's instructions for the material.
5. Soak part at temperature for required time or until uniformly heated.
6. Prepare quench bath according to requirements from manufacturer's handbook.
7. Remove part with tongs and plunge quickly into quench bath.
8. Agitate part in quench bath.
9. Remove, clean, and test its hardness with rockwell tester or file corner.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

5. TASK: Temper metals

PERFORMANCE OBJECTIVE

Provided with hardened part, manufacturer's handbook, drawing furnace, Rockwell tester, temper part to specifications.

TOOLS AND EQUIPMENT

Drawing furnace
Hardened part
Handbook
Rockwell tester

Tongs
Gloves
Face shield

PERFORMANCE GUIDE

1. Look up tempering (drawing) temperature in handbook.
2. Set furnace temperature.
3. Place part in furnace using tongs and soak at temp for required time.
4. Tempering should be done soon after hardening process, especially for some tool steels, check manufacturer's guidebook.
5. Remove from furnace and cool in air, on fire brick.
6. Test hardness when cool.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

6. TASK: Anneal metals

PERFORMANCE OBJECTIVE

Provided with a part or piece of steel that is too hard, heat treating furnace and Rockwell tester, anneal the part to a machinable, workable state.

TOOLS AND EQUIPMENT

Part
Heat treatment furnace
Face shield
Hardness tester
Handbook
Tongs
Gloves

PERFORMANCE GUIDE

1. Determine annealing temperature range and soaking time from the handbook.
2. Set furnace to correct temperature.
3. Place part in furnace using tongs and allow it to reach furnace temperature.
4. Soak at temperature for required to.
5. Remove part from furnace, cool slowly or allow furnace to cool to room temperature.
6. Test hardness when cool.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

7. TASK: Normalize metals

PERFORMANCE OBJECTIVE

Provided with a part or piece of steel with improper grain structure, charts, and heat treat furnace, normalize part to obtain better grain structure for further operations, machining, or heat treatment (i.e., forgings, machineing or heat treatment).

TOOLS AND EQUIPMENT

Heat treatment furnace
Part
Charts or handbook
Tongs
Gloves
Face shield

PERFORMANCE GUIDE

1. Determine proper normalizing temperature from charts or handbook.
2. Set oven to correct temperature.
3. Place part in oven using tongs and allow it to reach uniform temperature.
4. Remove part and rapidly air cool to room temperature.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

8. TASK: Case harden metals

PERFORMANCE OBJECTIVE

Provided with low carbon steel part, packing compound and heat treat, furnace, case hardened part. Part must pass file test.

TOOLS AND EQUIPMENT

Part
Heat treatment furnace
Charcoal
Container
File
Quench medium
Tongs
Gloves
Face shield
Handbook

PERFORMANCE GUIDE

1. Identify steel and required depth of case.
2. Set oven to correct temperature from handbook.
3. Pack part in charcoal inside stainless steel container; place into furnace using tongs.
4. Soak part at temperature for required time.
5. Remove container and cool to room temperature.
6. Remove part from packing material and container.
7. Reheat part to correct hardening temperature.
8. Remove and quench part.
9. Perform file test for hardness.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

9. TASK: Pre and postheat metals

PERFORMANCE OBJECTIVE

Provided with tool steel part and heat treating equipment, preheat metal for further treating operations or post heat for relief of stress following manufacturer's recommendations.

TOOLS AND EQUIPMENT

Heat treat furnace
Part
Tongs
Gloves
Face shield

PERFORMANCE GUIDE

1. Determine preheat or stress relief temperature for material.
2. Set furnace to proper temperature.
3. Place part in preheat furnace and soak to even temperature, then transfer part to hardening oven and follow hardening procedure.
4. If material requires post heating, check steel handbook and set drawing oven to temperature.
5. Remove residue from quenching operation and place part into furnace.
6. Remove and place in hardening oven.
7. Soak part at temp for required time.
8. Remove part and air cool.

DUTY N: PERFORMING HEAT TREATMENT OPERATIONS

10. TASK: Plan sequence of operations

PERFORMANCE OBJECTIVE

Furnished with a part drawing, plan a sequence of operations to heat treat a workpiece to print specs.

TOOLS AND EQUIPMENT

Heat treat furnace
Quenching medium
Hardness tester
Finishing/measuring/inspection tools
Part print

PERFORMANCE GUIDE

1. Review part print.
2. Sequence operations.
3. Productivity.
4. Safety.
5. Workpiece prep and handling.
6. Finish, measure, inspect to print specs.
7. Review sequence.
8. Record on operators form.

DUTY O: OPERATING NC/CNC

1. TASK: Determine operating conditions

PERFORMANCE OBJECTIVE

Furnished with part drawing, study the drawing and determine operating conditions for the job to machine. Must take into account tooling methods and setup information.

TOOLS AND EQUIPMENT

Drawing

PERFORMANCE GUIDE

1. Study drawing to determine methods.
2. List out tools needed.
3. Provide setup sketches of part locations, etc.
4. Determine operating conditions and record.
5. Provide information to operator about parallels needed, dowel pins, clamps, reference zero.

DUTY O: OPERATING NC/CNC

2. TASK: Set up machine

PERFORMANCE OBJECTIVE

Provided with drawing, operations and setup information, clamps, parallels, indicator, tools, set up the CNC machine.

TOOLS AND EQUIPMENT

Clamps
Parallels
Indicator
Tool holders
Wrenches

Dowel pins
Rags
Stud bolts and nuts
Cutting tools

PERFORMANCE GUIDE

1. Review drawing and operator's manual.
2. Mount work holding device(s).
3. Align work holding devices, if necessary.
4. Mount part on work holding device.
5. Install cutters into tool holders and secure.
6. If using automatic tool changer, load tools in changer; if NOT, lay tools out in order of use on a rag on the worktable.
7. Center spindle over zero reference with edge finder.
8. Read in tape and store program.
9. Move spindle away from part and set tool length offsets in registers.
10. Enter tool diameter offsets, if not entered in program.
11. Search for program sequence #N001.
12. Block all Z down moves.
13. Dry run program to check clearances and proof profile.
14. Return to zero.

NOTE: Some operators/programmers prefer to dry run program and actually scratch cut top of part over bluing, to allow actual measurements and easier part profile checks.

DUTY O: OPERATING NC/CNC

3. TASK: Run/machine parts with CNC

PERFORMANCE OBJECTIVE

Provided with CNC machine, part and part drawing, machine part(s). Part must meet drawing tolerances and/or tolerance of +/- 0.001".

TOOLS AND EQUIPMENT

CNC machine
Part(s)
Clamps
Bolts
Drawing
Measuring tools
Parallels
Assorted handtools

PERFORMANCE GUIDE

1. Set up machine tool.
2. Set operating conditions as previously practiced.
3. Run machine in manual/job to verify cutter path (with Z in zero lockout).
4. Machine first part to verify accuracy of setup and program.
5. Identify and edit programming errors.
6. Update programs stored in memory.
7. Identify and correct machine malfunctions.
8. Notify supervisor of discrepancies in parts.
9. Perform sequence search to edit or test part program.
10. Interpret status lights during operation.
11. If needed due to tool breakage or power failure, initiate program restart form zero reference.
12. Interrupt cycle to measure part, and resume cycle.
13. Check coolant levels.
14. Check surface finish.
15. Set cycle dwell when needed in operations to improve finish or obtain full depth.
16. Adjust Z depths in program.
17. Adjust cutter comp to achieve accuracy of cut and tolerance.
18. Complete operations and return to machine zero to inspect and unload part.
19. Do necessary exits to control operating conditions.

DUTY O: OPERATING NC/CNC

4. TASK: Enter program through MDI

PERFORMANCE OBJECTIVE

Provided with part drawing, manually written program, and CNC machine, enter the program into the controller via Manual Data Input. Program should be entered free of errors.

TOOLS AND EQUIPMENT

Part program and drawing
CNC machine

PERFORMANCE GUIDE

1. Select MDI mode on the controller.
2. Key in the manually written program.
3. Review program for errors after entering.

DUTY O: OPERATING NC/CNC

5. TASK: Modify MDI program

PERFORMANCE OBJECTIVE

Provided with controller, edits to make on program and manually written program, enter program and make corrections or edits. Program must be free of errors.

TOOLS AND EQUIPMENT

Edited program
CNC machine

PERFORMANCE GUIDE

1. Highlight edits in program.
2. Perform sequence search.
3. Replace program data.
4. Insert new moves and operations.
5. Check for errors.

DUTY O: OPERATING NC/CNC

6. TASK: Execute emergency stop

PERFORMANCE OBJECTIVE

Provided with part program and operating CNC machine, follow operations and execute emergency stop to avoid a crash. Machine must be reset to reference zero to begin program.

TOOLS AND EQUIPMENT

Part program
CNC machine tool

PERFORMANCE GUIDE

1. Set up and run CNC program.
2. Observe operation and clamp avoidance.
3. Be prepared or watch for tool breakage, a part moves, or a crash is eminent.
4. Execute emergency stop.
5. Relocate reference zero.
6. Sequence search to return to a valid starting point.
7. Resume machining.

NOTE: How to override hard or soft stops--Using manufacturing guidelines, remove axis off hard or soft over-travel.

DUTY O: OPERATING NC/CNC

7. TASK: Plan a sequence of operations

PERFORMANCE OBJECTIVE

Provided with part drawings, plan a sequence of operations to set up and machine a part with a CNC machine tool.

TOOLS AND EQUIPMENT

CNC machine tool
Work and tool holding
Cutting fluids
Part print
Workpiece material
Cutting tools
Finishing measuring/inspection tools

PERFORMANCE GUIDE

1. Review print.
2. Sequence operations.
3. Productivity.
4. Safety.
5. Work and tool mounting.
6. Parts finishing/inspection/measure.
7. Review sequence.
8. Record on opertors form.

NOTE: How to override hard or soft stops--Using manufacturing guidelines, remove axis off hard or soft over-travel.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

1. TASK: Install and maintain belt drives

PERFORMANCE OBJECTIVE

Provided machinery containing belt drive systems, install and maintain the belt drive. Work must conform to manufacturer's specifications.

TOOLS AND EQUIPMENT

Machinery
Belts and parts
Wrenches
Levers
Belt dressing

PERFORMANCE GUIDE

1. Install belts and pulleys in alignment.
2. Align and adjust tension of belt drives, do not over tension, check belt manufacturer's rules for tightness.
3. Maintain belt drives, check for wear and slippage, apply belt dressing where needed.
4. Construct belt joints with leather belts.
5. Troubleshoot system when reports of inefficiency arise.
6. Repair system when in need of repair and replacement of parts.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

2. TASK: Install and maintain chain drives

PERFORMANCE OBJECTIVE

Provided with machinery containing sprockets and chain drives, handtools, and manuals, install systems and maintain systems to manufacturer's recommendations.

TOOLS AND EQUIPMENT

Wrenches
Hammers
Levers
Grease
Oil
Machinery

PERFORMANCE GUIDE

1. Install chain and sprocket drive: Align and adjust tension of chain. Use adjustments on pillow block bearings. Do not over tighten.
2. Maintain chain and sprocket drives: Lubricate at regular intervals. Clean at regular intervals. Replace worn parts.
3. Inspect chain and sprockets: Check for bent or damaged parts. Check for chain link wear.
4. Troubleshoot drives: Listen for unusual noises. Check for slack in tension, may mean loss of tension or stretched chain.
5. Repair systems: Clean system. Remove master link to remove chain from sprocket.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

3. TASK: Install and maintain gear drives

PERFORMANCE OBJECTIVE

Provided machinery containing gear drive mechanisms, install parts and maintain system. Installation must conform to manufacturer's instructions.

TOOLS AND EQUIPMENT

Wrenches
Screwdrivers
Hammers
Rags
Manuals
Levers
Grease
Oil

PERFORMANCE GUIDE

1. Install and align gear drives: Check unit for proper lubricant. Check unit for direction of installation. Align using transit if necessary or measurements and calculations.
2. Maintain drives: Check lubricant levels. Check for misalignment after use. Clean drives.
3. Inspect various other drives: Rack and pinion. Ring and pinion. Gear boxes.
4. Repair gear drives: Determine what is needed. Replace parts versus make new. Make new parts, if needed.
5. Troubleshoot gear drives: Observe action of drive. Listen to action of drive.
6. Inspect wear on gear teeth.
7. Check gear teeth bachlash when installing new gears.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

4. TASK: Install and/or repair variable drives

PERFORMANCE OBJECTIVE

Provided machinery containing variable drives, install, inspect, and repair drive to manufacturer's standards.

TOOLS AND EQUIPMENT

Wrenches
Hammers
Screwdrivers
Flashlight
Manuals
Retaining ring pliers
Rags
Solvent

PERFORMANCE GUIDE

1. Inspect variable speed drives: Replace and install new ones.
2. Repair varidrives: Clean part. Remove outer retainer, lay parts in order of disassembly. Be careful of spring pressure. Remove from shaft. Check for broken springs, or keys or retaining rings, broken or work bearings.
3. Troubleshoot varidrives.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

5. TASK: Install and maintain couplings

PERFORMANCE OBJECTIVE

Provided equipment with couplings, tools and manuals, install, maintain couplings to builders specifications.

TOOLS AND EQUIPMENT

Wrenches
Screwdrivers
Levers
Manuals
Lubricant
Rags

PERFORMANCE GUIDE

1. Install couplings on equipment: Clean surfaces. Check clearances. Check alignment.
2. Align couplings.
3. Inspect couplings: For proper installation. For wear and lack of lubrication.
4. Troubleshoot couplings.
5. Disassemble and assemble couplings, as needed: Clean parts. Inspect for damaged parts. Lay out in order of disassembly.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

6. TASK: Replace and pack seals

PERFORMANCE OBJECTIVE

Provided equipment containing seals, with tools and manuals, replace and pack seals to manufacturer's recommendations.

TOOLS AND EQUIPMENT

Handtools
Grease
Manuals

PERFORMANCE GUIDE

1. Inspect packing and seals for leakage.
2. Remove packing and seals with handtools.
3. Clean and inspect area around seal for damage.
4. Replace seal and pack, grease.
5. Remove and replace mechanical seals.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

7. TASK: Install and align bearings

PERFORMANCE OBJECTIVE

Furnished equipment with bearings of all kinds, with tools, manuals, and new parts, install and align bearings to manufacturer's specifications.

TOOLS AND EQUIPMENT

Bearing pullers
Hammers
Spray lubricant
Indicator
Wrenches
Torch
Never Sezze compound
Alignment bar

PERFORMANCE GUIDE

1. Install pillow block bearings.
2. Align pillow blocks and bearings: Set up indicator and alignment shaft. Indicate both ends.
3. Remove and install bearings in bores: Remove retaining rings. Wipe out grease or oil. Apply Never Sezze compound. Attach bearing puller, and tap lightly until bearing breaks loose.
4. Remove and install bearings on shafts: Clean area. Remove any retaining rings. Apply Never Sezze. Attach bearing puller to shaft end, tongs on bearing. Apply even pressure, tap bearing with brass set to break loose. Continue turning screw until bearing comes off. Slide new bearing into place, tap on with ring against inner race, or use arbor press.
5. Troubleshoot bearings.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

8. TASK: Maintain and repair shafting

PERFORMANCE OBJECTIVE

Furnished equipment assembled with shafts, with tool, manuals, install and/or maintain shafts to manufacturer's standards.

TOOLS AND EQUIPMENT

Wrenches
Handtools
Presses
Indicators
Levers
Hoists

PERFORMANCE GUIDE

1. Install shaft.
2. Clean and inspect for damage and size.
3. Remove old shaft and replace if repair work.
4. Remove necessary companion parts.
5. Align shaft using indicators or lasers.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

9. TASK: Maintain and repair mechanisms

PERFORMANCE OBJECTIVE

Furnished with equipment containing mechanical moving parts, with tools, new parts, measuring tools, adjust and repair moving parts.

TOOLS AND EQUIPMENT

Wrenches
Hammers
Measuring tools
Pliers
Punches

PERFORMANCE GUIDE

1. Repair universal joint: Disassemble with retaining pliers and press. Replace bearings, pack. Assemble.
2. Install universal: Align, and lock in place.
3. Adjust gibs on equipment: Check for loose movement of part. Adjust and let run in.
4. Inspect linkages and lever mechanisms.
5. Troubleshoot linkages and level parts.
6. Repair linkages and levers.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

10. TASK: Repair clutches

PERFORMANCE OBJECTIVE

Given a centrifugal clutch, handtools, remove, install, or repair clutch mechanism. Must meet manufacturer's standards.

TOOLS AND EQUIPMENT

Handtools
Clutch
Manuals

PERFORMANCE GUIDE

1. Remove clutch with allen wrench or pin punch.
2. Inspect and replace, if nonrepairable.
3. Install in alignment with attaching holes, or with other parts.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

11. TASK: Install and maintain conveyers

PERFORMANCE OBJECTIVE

Provided with conveyer equipment, tools, and manuals, and plans, install and maintain the conveyors. Must meet drawing specifications.

TOOLS AND EQUIPMENT

Machine tools
Lifts
Manual
Transit
Welders
Handtools
Plans
Pinch bar

PERFORMANCE GUIDE

1. Assemble conveyor from component parts.
2. Align drive mechanism.
3. Fabricate guards.
4. Install guards.
5. Install conveyor into material handling system.
6. Troubleshoot conveyor.
7. Repair conveyor.

DUTY P: ASSEMBLE AND DISASSEMBLE MECHANISMS

12. TASK: Plan sequence of operation

PERFORMANCE OBJECTIVE

Furnished with mechanism drawings, plan a sequence of operations to assemble and disassemble mechanisms to required specs.

TOOLS AND EQUIPMENT

Assorted mechanisms to include flat and V belts, pulleys, shafts, gears, sprockets, chains, bearings, seals, clutches, conveyors, couplings, and variable speed drives, etc.
Assorted set of standard and millwright tools
Arbor press or bench press
Workbench with appropriate vises
Millwright guidelines handbook
Manufacturers manuals
Inspection tools

PERFORMANCE GUIDE

1. Review mechanism drawings.
2. Sequence operations.
3. Productivity.
4. Safety.
5. Operational to specs.
6. Review sequence.
7. Test completed mechanism.
8. Record processes on operators form.

DUTY Q: INSTALLING AND REMOVING MACHINERY

1. TASK: Prepare area for machine installation

PERFORMANCE OBJECTIVE

Provided with layout drawing, area for installation, and machine, make preparations for installation of machine. Machine must be installed to manufacturer's standards.

TOOLS AND EQUIPMENT

Level
Floor cleaner
Machinery installation bolts and pads
Transit
Concrete drill
Machine installation manual

PERFORMANCE GUIDE

1. Clean area to receive machine.
2. Study machine manual to determine correct installation.
3. Make preparations for new foundation, if necessary.
4. Excavate for any low sumps or hanging parts of machine.
5. Check level of floor.
6. Run a transit sitting if machine is large.
7. Lay out exact placement.
8. Drill hold down bolt holes, if needed, by machine installation.
9. Install bolts and cement in place.

DUTY Q: INSTALLING AND REMOVING MACHINERY

2. TASK: Raise machinery using jacks, bars, and blocks

PERFORMANCE OBJECTIVE

Furnished with the machinery to raise and the equipment to do so, raise the machine in place. Machine must be stable and create no safety hazard.

TOOLS AND EQUIPMENT

Jacks
Blocks
Pinch bar
Machinery manual

PERFORMANCE GUIDE

1. Evaluate the situation for space and safety measures and best measures to take.
2. Find an end that a pinch bar can fit under, place a block under back of pinch and one close to slip under machine.
3. Push down on bar and place small block under machine.
4. Proceed to opposite end and repeat steps.
5. Continue process until machine is high enough for next move.
6. If using a jack, find solid spot on base of machine to place jack and proceed as if using pinch bar, placing blocks under machine as you raise machine.

DUTY Q: INSTALLING AND REMOVING MACHINERY

3. TASK: Move machinery using forklift, slings, skids, and dollies

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PERFORMANCE OBJECTIVE

Provided with machinery to move, manual and a forklift, slings, skids, and dollies, move the machine to another location. Must be done to manual specifications and in a safe manner.

TOOLS AND EQUIPMENT

Forklift
Skids
Dollies
Machine manual

PERFORMANCE GUIDE

1. Read manual section on lifting machinery.
2. Determine method of moving.
3. Set forks on forklift as wide as possible to balance the weight of the machine, be sure forklift is rated to lift weight.
4. Place wood blocks to absorb weight and soften contact with machine.
5. Slowly bring forks in contact.
6. Watch signals of helper, and lift slowly.
7. Only lift high enough to make it across floor obstructions or to place on a skid or dollies.
8. Proceed to location slowly.
9. Only lift higher to get over obstruction, lower as soon as possible.
10. At location, move into position gently, lower by helper signals, lower slowly, slide around if needed with forks on lift truck.

DUTY Q: INSTALLING AND REMOVING MACHINERY

4. TASK: Move machinery using overhead crane and/or chainhoist

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PERFORMANCE OBJECTIVE

Provided with machinery to lift and move, a crane and/or chainhoist, lift and move the machine in a safe and expedient manner. Must be done to machinery manual.

TOOLS AND EQUIPMENT

Overhead crane
Chainhoist
Blocks
Manual

PERFORMANCE GUIDE

1. Align crane and install slings with wood braces against machinery.
2. Slowly lift to check balance.
3. Readjust, if needed.
4. Lift just enough to clear floor obstructions.
5. Use inch mode on crane, if available.
6. Use one or two spotters to guide machine and slow swing.
7. Using a chainhoist, rig over most support area, directly over machine, and brace beam.
8. Use same sequence as overhead crane from there on.

DUTY Q: INSTALLING AND REMOVING MACHINERY

5. TASK: Install machinery, position, level, and align

PERFORMANCE OBJECTIVE

Provided with moved machinery and tools, complete installation by positioning, leveling, and aligning machine. Must meet manual specifications.

TOOLS AND EQUIPMENT

Precision level
Transit

PERFORMANCE GUIDE

1. Jog machine around with pinch bar.
2. Run a sitting with a transit, if necessary.
3. Place precision level on smooth, firm machine surface.
4. Check at 90 degrees for twist in machine.
5. Shim and secure, as needed.
6. Check with level until level and without twist.

DUTY Q: INSTALLING AND REMOVING MACHINERY

6. TASK: Balance machinery

PERFORMANCE OBJECTIVE

Provided with installed machinery and vibration tester, balance machinery to factory specifications.

TOOLS AND EQUIPMENT

Vibration tester
Weights
Drill
Drill bits

PERFORMANCE GUIDE

1. Set up tester.
2. Run machine at low end and check results.
3. Run machine at high end and check results.
4. Adjust clamping.
5. Test again.
6. Apply weight or remove small amounts of weight by drilling.
7. Test again.

DUTY Q: INSTALLING AND REMOVING MACHINERY

7. TASK: Connect machinery to air or hydraulic source.

PERFORMANCE OBJECTIVE

Provided with setup machine, handtools, and connections, make necessary connect to air and/or hydraulic source. Must meet company and machinery standards.

TOOLS AND EQUIPMENT

Wrenches
Hose
Pipe
Plumbing tools
Clamps
Drill
Fittings
Teflon tape

PERFORMANCE GUIDE

1. Determine needs, air or hydraulic.
2. Select materials and source connection.
3. Shut down trunk line.
4. Break line, if no connection available.
5. Plumb new connection to machine, connecting to machine frame.
6. Make final connections at machine with hose or pipe, whichever is plant standard.
7. Purge line.
8. Open trunk line and test connections.

DUTY Q: INSTALLING AND REMOVING MACHINERY

8. TASK: Block, brace, and crib equipment for moving

PERFORMANCE OBJECTIVE

Provided with equipment to move, blocking and cribing, prepare for moving the equipment. Must be performed in a safe manner.

TOOLS AND EQUIPMENT

Equipment
Hammers
Nails
Wood cribbing
Wire

PERFORMANCE GUIDE

1. Evaluate job for best, easiest, and safest method.
2. Brace and support weaker sections.
3. Stack cribbing to support higher portions.
4. Cross brace and nail.
5. Use wire to apply tension in needed places.

DUTY Q: INSTALLING AND REMOVING MACHINERY

9. TASK: Plan a sequence of operation

PERFORMANCE OBJECTIVE

Furnished with an equipment layout drawing, plan the sequence of operations to install and remove machinery according to required specifications.

TOOLS AND EQUIPMENT

Machine to be installed and removed
Assortment of tools and handling equipment to include, wedges, roller dollies, skids, wheel sets, jacks, lever bars, roller shafts, shims, blocks, chains, sling hoist, levels, industrial power assembly tooling and materials
Assorted set of standard millwright tools
Anchoring fasterners and drilling mounting tools and floor patch
Jigs and fixtures for alignments
Millwrights handbook and guidelines
Manufactures installation and removal guidelines
Inspection tools

PERFORMANCE GUIDE

1. Review machinery installation and removal procedures manuals.
2. Sequence operations.
3. Safety (personal and equipment).
4. Productivity/professionialism.
5. Test rigidity and accuracy of installation.
6. Leave removal site in a sound professional condition (wiring, floor, hydraulics, etc.).
7. Review sequence.
8. Record processes on oprators form.

DUTY R: MAINTAIN HYDRAULIC SYSTEMS

1. TASK: Troubleshoot systems

PERFORMANCE OBJECTIVE

Provided with a hydraulic system, pressure gages, manuals, troubleshoot the system for cause of problem. Procedure must be done in safe and efficient manner and to manufacturer's standards.

TOOLS AND EQUIPMENT

Wrenches
Pressure and flow gages
Rags
Manuals

PERFORMANCE GUIDE

1. Check power source for power.
2. Check hoses and connections for leaks.
3. Check for clogged filters.
4. Check fluid level in sump.
5. Check flow and pressure at pump.
6. Check flow and pressure down line at connections of other implements or fittings.
7. Check viscosity of hydraulic fluid.

DUTY R: MAINTAIN HYDRAULIC SYSTEMS

2. TASK: Perform preventative maintenance

PERFORMANCE OBJECTIVE

Provided with a hydraulic system, set up and conduct preventative maintenance schedule. Must be done to manufacturer's recommendations in implement manuals.

TOOLS AND EQUIPMENT

System
Filters
Hoses
Fluid
Rags
Seals

PERFORMANCE GUIDE

1. Set up and conduct fluid and filter changes on regular monthly basis, or on basis of hours run time, particularly if system is under heavy use.
2. Check hoses for wear and weak spots, and replace, as needed.
3. Run pressure check on hoses and fittings.
4. Inspect and replace worn seals in pumps and cylinders.
5. Cleanup excess fluids and spills.
6. Dispose of excess fluid, rags, and filters in a safe manner.

DUTY R: MAINTAIN HYDRAULIC SYSTEMS

3. TASK: Perform basic repair

PERFORMANCE OBJECTIVE

Assigned to a hydraulic system in need of repair, extra components, tools, seals replace and/or repair system to working condition. Must be completed to plant standards and manual specs.

TOOLS AND EQUIPMENT

Hoses
Seals
Pump rotor
Allen wrenches
Screwdrivers
Fittings
Valves
Cylinder
Wrenches
Scrapers

PERFORMANCE GUIDE

1. Shutdown system.
2. Determine part or parts in need of repair or replacement, disassemble. Inspection may need to take place first.
3. Remove connecting hoses.
4. Remove cover plate on pump and inspect rotor.
5. Remove rotor and inspect, replace as needed.
6. Check seals and replace as needed.
7. Check valves for leak back, check ball, check valves, and replace as needed.
8. Replace hoses, as needed.
9. Be sure to work clean, do not leave debris in parts, or system.
10. Reassemble system and checkout.

DUTY R: MAINTAIN HYDRAULIC SYSTEMS

4. TASK: Perform tests on systems

PERFORMANCE OBJECTIVE

Assigned to a hydraulic system, with test tools and gages needed, conduct tests on system for timing, pressure, flow, and lift capacity. Must be completed to standards of machinery manufacturer.

TOOLS AND EQUIPMENT

Pressure gage
Flow meter
Watch
Weights
Manuals

PERFORMANCE GUIDE

1. Shutdown system, and connect pressure and flow gages.
2. Turn system on and take readings.
3. Shut down system and remove gages.
4. Time reactions of system at partial open flow valve and at full open valve.
5. Weight arm or lift forms and test lift and timing.
6. Record all data and compare to specifications.

DUTY R: MAINTAIN HYDRAULIC SYSTEMS

5. TASK: Measure pressure and flow

PERFORMANCE OBJECTIVE

Provided with pressure gage and flow meter, hydraulic system, and tools, measure the pressure and flow within the system and compare to system specifications. Must be completed in safe and orderly manner.

TOOLS AND EQUIPMENT

System
Pressure gage
Flow meter
Rags
Wrenches

PERFORMANCE GUIDE

1. Shut down system and attach pressure gage at pump.
2. Turn on system and measure pressure in psi.
3. Remove gage and attach farther down line and measure flow, calculate differential through system.
4. Attach flow meter with system shut down.
5. Start system and measure flow.
6. Compare gpm to pump specs and system specs.

DUTY R: MAINTAIN HYDRAULIC SYSTEMS

6. TASK: Inspect parts and systems

PERFORMANCE OBJECTIVE

Assigned to a hydraulic system, and provided lights, rags, and schematic, inspect system for installation and system problems. Must be done in a safe manner and to operating procedures.

TOOLS AND EQUIPMENT

Flashlight
Schematic
Rags

PERFORMANCE GUIDE

1. Observe system in operation for leaks, and jerky operation.
2. Shut down system and check all fittings and joints for snug fit.
3. Check components for secure attachment to structure or machine.

DUTY S: MAINTAIN PNEUMATIC SYSTEMS

1. TASK: Troubleshoot pneumatic systems

PERFORMANCE OBJECTIVE

Provided a pneumatic system on a machine, manuals, schematic, and tools, troubleshoot system for problem. Must be conducted in safe, orderly, and timely manner.

TOOLS AND EQUIPMENT

Flashlight
Mirror
Rags
Basic handtools

PERFORMANCE GUIDE

1. Observe system in operation.
2. Listen for air leaks.
3. Check water trap.
4. Check hoes and couplings for wear and fatigue.
5. Check cylinders for leaks and bent parts.
6. Check for interference in installation.

DUTY S: MAINTAIN PNEUMATIC SYSTEMS

2. TASK: Perform preventative maintenance

PERFORMANCE OBJECTIVE

Assigned to a machine with pneumatics, tools, and manuals, set up and perform, or take steps toward preventative maintenance on the system. Must follow manufacturer's recommendations and instructions.

TOOLS AND EQUIPMENT

Manuals
Rags
Flashlight
Gaskets
Hoses
Wrenches

PERFORMANCE GUIDE

1. Set up regular interval checks.
2. Empty water trap weekly or more often, depending on moisture in air.
3. Replace gasket in trap.
4. Replace hoses when needed.
5. Check and fill oiler system if air line installed with oiler.

DUTY S: MAINTAIN PNEUMATIC SYSTEMS

3. TASK: Install or replace components

PERFORMANCE OBJECTIVE

Provided with components, pneumatic system, and machine, install or replace components. Must meet system design and manufacturer's standards.

TOOLS AND EQUIPMENT

Miscellaneous components
Handtools
Wrenches
Rags
Teflon tape
Screwdrivers

PERFORMANCE GUIDE

1. Inspect part to be installed or replaced. Read instructions for locations and clamping, etc.
2. Shut down air supply to trunk line.
3. Remove component.
4. Replace with new or rebuilt part, use teflon tape on threaded joints.
5. Secure part in position.
6. Turn on air and check system for leaks and function.

DUTY S: MAINTAIN PNEUMATIC SYSTEMS

4. TASK: Repair components and air leaks

PERFORMANCE OBJECTIVE

Provided components of a pneumatic system in need of repair, new parts, wrenches, and screwdriver, disassemble and repair components. Must be completed to manufacturer's specifications.

TOOLS AND EQUIPMENT

Assorted components
Tools
O-rings
Pistons
Arms, etc.

PERFORMANCE GUIDE

1. Remove components from machinery.
2. Clean components.
3. Disassemble cylinders with wrench.
4. Pull out piston.
5. Replace o-ring and place piston in cylinder.
6. Assemble cylinder in position and test.
7. Remove water trap and replace o-ring seal.
8. Replace water trap bowl, if cracked.
9. Disassemble and replace valves.
10. Check valves.

DUTY S: MAINTAIN PNEUMATIC SYSTEMS

5. TASK: Inspect parts and systems

PERFORMANCE OBJECTIVE

Provided with system and flashlight, inspect system for malfunction and leaks. Must be done in safe and orderly fashion.

TOOLS AND EQUIPMENT

System
Flashlight
Rags

PERFORMANCE GUIDE

1. Observe system in operation.
2. Listen for air leaks.
3. Check for loose components in system.
4. Check efficiency of operation.

DUTY S: MAINTAIN PNEUMATIC SYSTEMS

6. TASK: Measure air pressure

PERFORMANCE OBJECTIVE

Provided with system, pressure gage, and handtools, check system for air pressure drops. Must be completed in safe manner.

TOOLS AND EQUIPMENT

Air pressure gage
Rags
Wrenches
Fittings

PERFORMANCE GUIDE

1. Check air pressure at gage.
2. Check pressure at valve.
3. Check pressure at piston or nozzle.
4. Determine cause of any pressure drops.

DUTY T: MAINTAIN ELECTRONIC CONTROL SYSTEMS

1. TASK: Troubleshoot control systems

PERFORMANCE OBJECTIVE

Provided schematic, VOM, and control system, perform troubleshooting on the system. Must be done in safe manner and to manufacturer's standards.

TOOLS AND EQUIPMENT

Volt/Ohm meter
Schematic

PERFORMANCE GUIDE

1. Verify servo amplifier operation. Check circuit for current with VOM.
2. Verify servo motor control circuits with VOM.
3. Verify terminal device operation; test circuit with VOM.
4. Check communication link circuits.
5. Check printed circuit board.
6. Check position device circuit.
7. Check robot controller circuit.
8. Diagnose malfunctions with test instruments.

DUTY T: MAINTAIN ELECTRONIC CONTROL SYSTEMS

2. TASK: Perform preventative maintenance

PERFORMANCE OBJECTIVE

Assigned to a control unit, set up and complete preventative maintenance on unit. Must be completed safely and to manufacturer's recommendations.

TOOLS AND EQUIPMENT

Assorted handtools
Antistatic compound

PERFORMANCE GUIDE

1. Clean components.
2. Check seals for leaks in cabinets and replace.
3. Spray with antistatic spray.

DUTY T: MAINTAIN ELECTRONIC CONTROL SYSTEMS

3. TASK: Perform adjustments on control systems

PERFORMANCE OBJECTIVE

Provided control system, make needed adjustments with test equipment and handtools or special tools provided. Must be completed in a safe manner.

TOOLS AND EQUIPMENT

Test equipment
Handtools
Schematic

PERFORMANCE GUIDE

1. Check schematic for adjustment controls.
2. Take any electrical readings.
3. Fine tune adjustments.
4. Check performance after adjustments.
5. Adjust control system feedback loops.

DUTY T: MAINTAIN ELECTRONIC CONTROL SYSTEMS

4. TASK: Interpret control diagrams

PERFORMANCE OBJECTIVE

Provided with control diagrams and systems, interpret diagrams and trace system. Must identify all components.

TOOLS AND EQUIPMENT

Diagram
System

PERFORMANCE GUIDE

1. Study diagram.
2. Note components and locations and functions.
3. Note circuitry, inputs, and outputs.
4. Draw a sketch of system on machine and location of all components.

DUTY U: MAINTAIN AUTOMATED SYSTEMS

1. TASK: Troubleshoot system components

PERFORMANCE OBJECTIVE

Provided with an automated system, test equipment, troubleshoot the system for malfunction and misadjustment to meet standards.

TOOLS AND EQUIPMENT

Test equipment
Wrenches
Screwdrivers
Lights
Mirrors

PERFORMANCE GUIDE

1. Run diagnostic routine.
2. Check effectors.
3. Check automatic lubrication system.
4. Check vision system.
5. Check timing of system.
6. Check overload devices.

DUTY U: MAINTAIN AUTOMATED SYSTEMS

2. TASK: Adjust systems

PERFORMANCE OBJECTIVE

Provided automated systems, equipment, and tools, make adjustments to system to manual specifications.

TOOLS AND EQUIPMENT

Test equipment
Assorted handtools

PERFORMANCE GUIDE

1. Adjust clutch and brake system components.
2. Adjust linkages.

DUTY U: MAINTAIN AUTOMATED SYSTEMS

3. TASK: Apply service bulletin requirements

PERFORMANCE OBJECTIVE

Furnished with service bulletins for system, review and apply all requirements to system.

TOOLS AND EQUIPMENT

Service bulletin

PERFORMANCE GUIDE

1. Set up preventative maintenance program to bulletin requirements.
2. Assign duties of plan.
3. Review plan with manager.
4. Test plan.

DUTY U: MAINTAIN AUTOMATED SYSTEMS

4. TASK: Disassemble, repair, and test systems

PERFORMANCE OBJECTIVE

Provided a robot from automated system, manuals, and tools, disassemble, test, and repair robot to manual requirements. Perform in safe manner.

TOOLS AND EQUIPMENT

Manuals
Robot
Assorted handtools
Lubricant
Rags

PERFORMANCE GUIDE

1. Disassemble robot with tools, and clean parts, organize in order of disassembly.
2. Repair robot, replace parts with new, rebuild parts, if possible, in machine shop and weld shop.
3. Test robots, mechanical and other component systems.

DUTY U: MAINTAIN AUTOMATED SYSTEMS

5. TASK: Maintain automated systems

PERFORMANCE OBJECTIVE

Provided with automated system, manuals, preventative maintenance plans, maintain robot and system to manufacturer's standards.

TOOLS AND EQUIPMENT

Maintenance plan
Spare parts
Test tools
Assorted tools and shops

PERFORMANCE GUIDE

1. Inspect system for wear and breakdowns.
2. Check for loose parts.
3. Check lubrication levels.

DUTY V: INSTALL AUTOMATED SYSTEMS

1. TASK: Install robots

PERFORMANCE OBJECTIVE

Provided with robot, resources, plans, and personnel, install robot into a system. Must be done in safe manner, and to specifications.

TOOLS AND EQUIPMENT

Robot
Drills
Wrenches
Hammers
Crane

PERFORMANCE GUIDE

1. Prepare area for installation, foundation, hold downs.
2. Move robot to area and install in placement zone.
3. Install and adjust arms/effectors.
4. Install actuators.
5. Interconnect robot to other equipment.
6. Verify interlock operation.
7. Install robot controller.
8. Install programmable controller.
9. Install input/output devices.
10. Install combination links.

DUTY V: INSTALL AUTOMATED SYSTEMS

2. TASK: Install workcell

PERFORMANCE OBJECTIVE

Provided all the necessary tools and equipment, install the total workcell to drawing specifications.

TOOLS AND EQUIPMENT

Assorted tools
CAD system
Heavy equipment

PERFORMANCE GUIDE

1. Lay out cell on CAD system.
2. Lay out cell on floor of cell area.
3. Assemble tools.
4. Install cell equipment around installed robot.
5. Measure each placement carefully.
6. Secure equipment in place.
7. Test run system at job mode.

DUTY V: INSTALL AUTOMATED SYSTEMS

3. TASK: Test automated systems

PERFORMANCE OBJECTIVE

Provided with installed system, manuals, and test parts, test the automated system in a safe manner and to manual specifications.

TOOLS AND EQUIPMENT

Test parts

PERFORMANCE GUIDE

1. Test initial start-up of robotic system.
2. Test initial start-up of workcell.
3. Test start-up of automated system.
4. Analyze operating difficulties and adjust to specifications.

DUTY V: INSTALL AUTOMATED SYSTEMS

4. TASK: Measure robot performance

PERFORMANCE OBJECTIVE

Provided with robotic system, measuring devices, and test equipment, measure the performance of the system to manual standards.

TOOLS AND EQUIPMENT

Test devices

PERFORMANCE GUIDE

1. Measure positioning performance to percent of allowable error.
2. Measure overall performance.
3. Measure repeatability performance.
4. Analyze problems and make adjustments.

DUTY V: INSTALL AUTOMATED SYSTEMS

5. TASK: Troubleshoot system

PERFORMANCE OBJECTIVE

Furnished with a robotic system and troubleshooting manual, troubleshoot the system for inadequacies and misadjustments.

TOOLS AND EQUIPMENT

Timing devices

PERFORMANCE GUIDE

1. Analyze sensing requirements.
2. Analyze operating difficulties.
3. Follow manufacturer's troubleshooting procedures.

DUTY V: INSTALL AUTOMATED SYSTEMS

6. TASK: Optimize system

PERFORMANCE OBJECTIVE

Furnished with system, optimize operation of system to manufacturing standards.

TOOLS AND EQUIPMENT

Adjustment and testing tools

PERFORMANCE GUIDE

1. Adjust air and/or hydraulic systems.
2. Adjust controllers.

DUTY V: INSTALL AUTOMATED SYSTEMS

7. TASK: Design systems

PERFORMANCE OBJECTIVE

Provided with researched needs of a system, CAD system, design a robotic system to needs analysis.

TOOLS AND EQUIPMENT

CAD system

PERFORMANCE GUIDE

1. Design robot to pick and place.
2. Design system for counting regular shaped parts.
3. Design a system to count irregular shaped parts.
4. Coordinate robot with more than one piece of equipment.

DUTY V: INSTALL AUTOMATED SYSTEMS

8. TASK: Adjust system

PERFORMANCE OBJECTIVE

Provided with system, tools, and manuals, adjust system to operate in workcell. Must be adjusted to implement plans and design plans.

TOOLS AND EQUIPMENT

Test equipment
Sample parts

PERFORMANCE GUIDE

1. Adjust coordinate system.
2. Adjust sensing requirements.
3. Adjust for accuracy and repeatability.

DUTY V: INSTALL AUTOMATED SYSTEMS

9. TASK: Start system and shut down system

PERFORMANCE OBJECTIVE

Provided with automated system, perform a start up and shut down procedure. Follow manufacturer's procedures, and perform in safe manner.

TOOLS AND EQUIPMENT

Manual

PERFORMANCE GUIDE

1. Study manual for procedures.
2. Clear area of personnel.
3. Start system and let run for short period.
4. Shut down and shut off power.

DUTY H: PROGRAMMING AND PLANNING

1. TASK: Write a CNC program

PERFORMANCE OBJECTIVE

Provided with part drawing and specifications, write a CNC program to machine part to tolerances specified on part drawing and/or +/- 0.0005".

TOOLS AND EQUIPMENT

Drawing
Specifications

PERFORMANCE GUIDE

1. Select machine tool for part.
2. Prepare part setup plan.
3. Determine absolute or incremental mode.
4. Compute polar/rectangular coordinates.
5. Compute part geometry.
6. Define cutter path and verify cutter path.
7. Plot program.
8. Program tool changes.
9. Select canned cycles.
10. Program restart points.
11. Prepare operator messages.
12. Calculate run time.
13. Prepare tape.

DUTY W: PROGRAMMING AND PLANNING

2. TASK: Program with integrated graphic programming system

PERFORMANCE OBJECTIVE

Provided with graphic programming system, part drawing, and specifications, program part and generate code from system.

TOOLS AND EQUIPMENT

Graphic programming station

PERFORMANCE GUIDE

1. Define cutter path.
2. Depict part graphically, and verify cutter path on screen.
3. Generate code.
4. Prepare tape or send direct to machine tool.

DUTY W: PROGRAMMING AND PLANNING

3. TASK: Design fixturing and clamping

PERFORMANCE OBJECTIVE

Provided with part drawings and operations sheet, design part holding fixtures or clamping system. Part must be held in fixture to a tolerance of +/- 0.0001".

TOOLS AND EQUIPMENT

CAD system (optional)
Part drawing
Operations

PERFORMANCE GUIDE

1. Design special fixtures for custom job.
2. Design clamps and holders for custom job.

DUTY W: PROGRAMMING AND PLANNING

4. TASK: Update programs from engineering changes

PERFORMANCE OBJECTIVE

Provided with engineering changes, part drawing, NC editor, or graphic system, make programming changes to drawing tolerances.

TOOLS AND EQUIPMENT

NC editor or graphic programming system

PERFORMANCE GUIDE

1. Note changes in tooling.
2. Note changes in depths or contours.
3. Edit NC program in correct sections.
4. Verify new cutter path on plotter or graphic system.
5. Create new machine code.

DUTY W: PROGRAMMING AND PLANNING

5. TASK: Schedule programs and second operations

PERFORMANCE OBJECTIVE

Provided with NC programs, machine schedules, schedule when programs will be run and where and when any second operation will be done.

TOOLS AND EQUIPMENT

Schedule board

PERFORMANCE GUIDE

1. Check CNC machine backlog and expected finish dates and schedule new program.
2. Check needs for second ops and schedule machines.

DUTY X: PERFORMING OPERATING FUNCTIONS OF AUTOMATED SYSTEM

1. TASK: Assist in implementation plan

PERFORMANCE OBJECTIVE

Assist the supervisor in implementing plan for initial setup, installation, and maintenance of automated system. Follow manufacturer's or engineer's specifications.

TOOLS AND EQUIPMENT

Manuals
Engineer's specs

PERFORMANCE GUIDE

1. Study manuals and specs.
2. Work as a team member with supervisor in designing implementation plan.

DUTY X: PERFORMING OPERATING FUNCTIONS OF AUTOMATED SYSTEM

2. TASK: Determine resources

PERFORMANCE OBJECTIVE

Provided plans and expected outcomes, determine the resources needed to continue production.

TOOLS AND EQUIPMENT

Plans

PERFORMANCE GUIDE

1. Review plans and expected outcomes.
2. Locate resources.

DUTY X: PERFORMING OPERATING FUNCTIONS OF AUTOMATED SYSTEM

3. TASK: Coordinate within department and outside department

PERFORMANCE OBJECTIVE

Assigned project of implementing initial setup, coordinate with other workers to complete the task. Follow company policies on working with other departments.

TOOLS AND EQUIPMENT

PERFORMANCE GUIDE

1. Determine the other personnel that must be involved.
2. Follow lines of command.
3. Develop working relationships.
4. Plan team approach to task.
5. Implement plan.

DUTY Y: PERFORM COMMUNICATION FUNCTIONS

1. TASK: Prepare reports

PERFORMANCE OBJECTIVE

Acting as a team leader of projects, prepare reports for supervisors and peers on the project. Must follow company standards.

TOOLS AND EQUIPMENT

Word processor

PERFORMANCE GUIDE

1. Prepare technical reports to include: charts, graphs, status reports, project summary, and manuals.
2. Review for accuracy.

DUTY Y: PERFORM COMMUNICATION FUNCTIONS

2. TASK: Make presentations

PERFORMANCE OBJECTIVE

Acting as team leader of project, make oral presentations to management and fellow workers.

TOOLS AND EQUIPMENT

Presentation equipment

PERFORMANCE GUIDE

1. Make organized presentations and include: charts, graphs, and descriptions.
2. Prepare closing comments.
3. Prepare question and answer period.

DUTY Y: PERFORM COMMUNICATION FUNCTIONS

3. TASK: Interface with vendors

PERFORMANCE OBJECTIVE

Assigned the responsibility and time, interface with vendors for needs of the department or assigned project. Must be conducted according to company policy.

TOOLS AND EQUIPMENT

Telephone
Catalogs

PERFORMANCE GUIDE

1. Be professional at all times.
2. Be courteous.
3. Create a sound working relationship.

DUTY Y: PERFORM COMMUNICATION FUNCTIONS

4. TASK: Demonstrate Equipment

PERFORMANCE OBJECTIVE

Provided the assignment, equipment, and manuals; demonstrate how equipment works to fellow workers and/or supervisor.

TOOLS AND EQUIPMENT

Machine manuals

PERFORMANCE GUIDE

1. Study manuals.
2. Organize demonstration.
3. Practice demonstration.
4. Speak clearly and slowly enough so that you can be heard.
5. Provide for questions and hands-on time.
6. Determine safety points to cover during demonstration.

DUTY Y: PERFORM COMMUNICATION FUNCTIONS

5. TASK: Conduct Training

PERFORMANCE OBJECTIVE

Provided with assigned personnel for training, train another in the operation of equipment. Must be done safely and include all necessary information for proper operation.

TOOLS AND EQUIPMENT

PERFORMANCE GUIDE

1. Start with the basics.
2. Organize training.
3. Provide for trainee input and questions.
4. Make training hands-on.
5. Instruct in all safety aspects.

DUTY Z: PERFORMING QUALITY CONTROL/QUALITY ASSURANCE

1. TASK: Develop standards

PERFORMANCE OBJECTIVE

Provided industrial quality control/quality assurance standards. Define each standard and describe the use.

TOOLS AND EQUIPMENT

Pencil, paper or computer word processor, standards guide lines

PERFORMANCE GUIDE

1. Identify standards
2. Define and describe use
3. With the use of a word processor, prepare a technical report of industrial standards related to quality control/quality assurance (evaluation--25 percent - heading, 50 percent - content, 25 percent - neatness, organization).

DUTY Z: PERFORMING QUALITY CONTROL/QUALITY ASSURANCE

2. TASK: Implement standards and procedures

PERFORMANCE OBJECTIVE

Demonstrate the knowledge and skill in performing quality control and QA on parts and process.

TOOLS AND EQUIPMENT

Standards tech report
Measuring tools
Prints and specs
Parts
Implementation guidelines

PERFORMANCE GUIDE

1. Review standards.
2. Check processes/procedures.
3. Perform QC/QA to demo skill and knowledge.
4. Record data.
5. Report findings for acceptances, rework or scrap.

DUTY Z: PERFORMING QUALITY CONTROL/QUALITY ASSURANCE

3. TASK: Conduct quality test

PERFORMANCE OBJECTIVE

Provided part(s) inspection instruments and process, conduct quality test on supplied parts to drawing specifications and quality control/quality assurance standards.

TOOLS AND EQUIPMENT

Drawing
Quality control/quality assurance guidelines
Inspection tools

PERFORMANCE GUIDE

1. Check process.
2. Set up process.
3. Perform quality test.
4. Record data.
5. Make recommendations.

DUTY Z: PERFORMING QUALITY CONTROL/QUALITY ASSURANCE

4. TASK: Calibrate equipment

PERFORMANCE OBJECTIVE

Provided QC/QA tools, calibrate to assigned standards.

TOOLS AND EQUIPMENT

QC/QA tools
Specifications and standards
Procedure notes and check sheet
Calibration guidelines

PERFORMANCE GUIDE

1. Check procedures.
2. Set tools to standards.
3. Document processes.

DUTY Z: PERFORMING QUALITY CONTROL/QUALITY ASSURANCE

5. TASK: Apply statistical process control

PERFORMANCE OBJECTIVE

Provided with SPC software and computer, setup an assigned industrial QC/QA problem and solve for assigned data simulation.

TOOLS AND EQUIPMENT

Computer
SPC software
Printer
SPC guidelines

PERFORMANCE GUIDE

1. Install computer software
2. Input the simulation problem
3. Demonstrate the SPC process
4. Print documentation
5. Evaluate and compare data to required standards
6. Make necessary adjustments within the process to meet assigned specifications.

DUTY Z: PERFORMING QUALITY CONTROL/QUALITY ASSURANCE

6. TASK: Integrate quality engineering

PERFORMANCE OBJECTIVE

Provided a QC/QA process flow plan, identify and document the integration of quality engineering within the flow, complete with closed feedback.

TOOLS AND EQUIPMENT

QC/QA process flow plan
Computer
Printer
Integration guidelines

PERFORMANCE GUIDE

1. Observe an in-plant quality engineering integrated QC/QA process.
2. Identify the integration aspects.
3. Prepare a written document to describe integrated quality engineering through a technical report (evaluation--25 percent - heading, 50 percent - content, 25 percent - neatness/organization). Closed loop.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

1. TASK: Clean and maintain work area

PERFORMANCE OBJECTIVE

Provided workspace, jobs, and cleaning equipment, clean and maintain work area to company standards and safety standards.

TOOLS AND EQUIPMENT

Shovels
Brooms
Floor sweep
Rags
Barrels

PERFORMANCE GUIDE

1. Properly dispose of scrap metal chips, shavings, trash, and waste emphasizing safety and following disposal guidelines.
2. Clean and store handtools, cutters, fixtures, jigs, and attachments.
3. Store grinding wheels on wheel board.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

2. TASK: Clean and store tools and tooling

PERFORMANCE OBJECTIVE

Provided working environment, safely clean and store tools and tooling in assigned places. Must meet company standards.

TOOLS AND EQUIPMENT

Storage area
Tools and tooling

PERFORMANCE GUIDE

1. Clean tools.
2. Store handtools.
3. Store cutters in cabinets.
4. Store jigs and fixtures in tooling area.
5. Store grinding wheels in special cabinets.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

3. TASK: Inspect guarding

PERFORMANCE OBJECTIVE

Provided with machines and equipment, inspect and maintain guarding to safety standards. Must meet manufacturer's standards.

TOOLS AND EQUIPMENT

Guarding
Handtools

PERFORMANCE GUIDE

1. Inspect machine guards for safety and wear.
2. Remove guards with tools.
3. Replace guards.
4. Adjust guard for proper clearance and unrestricted use.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

4. TASK: Paint machines

PERFORMANCE OBJECTIVE

Provided a machine in need of refinishing, painting equipment, prepare and paint machine. Must be done to paint manufacturer's directions.

TOOLS AND EQUIPMENT

Sanders
Abrasive cloth
Thinner
Paint
Brush
Spray equipment

PERFORMANCE GUIDE

1. Mask off machined surface.
2. Sand machine.
3. Apply primer, if needed.
4. Paint machine with brush or spray.
5. Dispose of waste properly.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

5. TASK: Report problems to supervisor

PERFORMANCE OBJECTIVE

Provided working environment, determine importance of problems and report to supervisor. Use company procedures and forms.

TOOLS AND EQUIPMENT

Forms
Procedures

PERFORMANCE GUIDE

1. Evaluate problem.
2. Contact supervisor and explain problem.
3. Provide in written form, if asked.
4. Be clear and explicit.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

6. TASK: Complete forms

PERFORMANCE OBJECTIVE

Provided working environment and company reporting systems, complete necessary forms in line of duty. Must be done to company standards.

TOOLS AND EQUIPMENT

Forms

PERFORMANCE GUIDE

1. Complete timecards.
2. Complete job status reports.
3. Make equipment failure reports.
4. Record preventative maintenance activities.
5. Record repair activities.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

7. TASK: Read job orders and process sheets

PERFORMANCE OBJECTIVE

Assigned a part drawing, operation sheets, machine, read job orders and process sheet or complete part. Part must meet drawing specifications.

TOOLS AND EQUIPMENT

Process sheet
Job order

PERFORMANCE GUIDE

1. Read job order for numbers and material, and numbers for timecard.
2. Read process sheets for setup information and machining sequence, special operations, or deviations from drawing.

DUTY AA: PERFORM HOUSEKEEPING/RECORDKEEPING

8. TASK: Determine basic maintenance procedures

PERFORMANCE OBJECTIVE

Assigned a machine, determine maintenance procedures to correct basic problems. Must follow company policy.

TOOLS AND EQUIPMENT

Manual
Company policy

PERFORMANCE GUIDE

1. Determine problem.
2. Determine gravity of problem.
3. Is it operator fixable or must maintenance be called in?
4. Inform supervisor.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

1. TASK: Determine availability of resources

PERFORMANCE OBJECTIVE

Provided the responsibility, assignments, materials, equipment, and job orders, determine availability of resources to complete the jobs in the estimated timeline.

TOOLS AND EQUIPMENT

Plant resources
People

PERFORMANCE GUIDE

1. Determine availability of machines.
2. Assign machines.
3. Determine availability of supplies.
4. Assign supplies.
5. Determine availability of materials.
6. Assign materials to jobs.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

2. TASK: Secure resources

PERFORMANCE OBJECTIVE

Given the assignment, secure resources to complete the assigned task. Must be completed through company channels.

TOOLS AND EQUIPMENT

Order forms

PERFORMANCE GUIDE

1. Requisition supplies and materials.
2. Schedule supplies and materials to arrive at times needed.
3. Distribute supplies and materials. Use line of authority, and assign to leadperson or administrative assistant.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

3. TASK: Coordinate personnel

PERFORMANCE OBJECTIVE

Assigned supervisory functions, coordinate personnel. Must follow company rules and policies.

TOOLS AND EQUIPMENT

Policy handbook

PERFORMANCE GUIDE

1. Coordinate workers with work to be completed.
2. Write work schedules and post.
3. Schedule and control shop flow of jobs. Use scheduling software.
4. Explain work requirements.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

4. TASK: Maintain records

PERFORMANCE OBJECTIVE

Provided assignment, keep accurate records of all transactions and operations. Follow company standards.

TOOLS AND EQUIPMENT

Company files and records

PERFORMANCE GUIDE

1. Maintain files.
2. Maintain production records.
3. Maintain warranty records.
4. Maintain charts, tables, or status boards on work schedule (or software database).
5. Check job/timecards.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

5. TASK: Review work orders

PERFORMANCE OBJECTIVE

Provided the opportunity in assignments, review all work orders for accurate information and correct designation. Follow company standards.

TOOLS AND EQUIPMENT

Work orders

PERFORMANCE GUIDE

1. Review job orders for all information. Check route and parts ordered.
2. Review process sheets and machine assignments.
3. Review part drawing specifications.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

6. TASK: Issue work orders

PERFORMANCE OBJECTIVE

Assigned responsibility and stewardship, and after reviewing drawing specifications and job orders, issue job orders to assigned personnel.

TOOLS AND EQUIPMENT

Forms

PERFORMANCE GUIDE

1. Issue part drawings.
2. Issue job orders.
3. Issue process sheets.
4. Explain work requirements to operators and leadpeople.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

7. TASK: Write reports

PERFORMANCE OBJECTIVE

In the course of fulfilling assignments, write necessary reports to complete job assignments. Follow company standards and standard report forms.

TOOLS AND EQUIPMENT

Format
Word processor

PERFORMANCE GUIDE

1. Write technical reports.
2. Write reports on progress of production.
3. Write quarterly profit--loss reports.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

8. TASK: Perform inventory functions

PERFORMANCE OBJECTIVE

Assigned the responsibility, provided materials, process, and time, perform inventory of materials and supplies. Must be done to company standards.

TOOLS AND EQUIPMENT

Word processor
Format
Forms

PERFORMANCE GUIDE

1. Organize process.
2. Weigh out stock.
3. Count materials; i.e., screws, etc.
4. Mark equipment no longer in service or in need of repair/maintenance.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

9. TASK: Conduct inspection activities

PERFORMANCE OBJECTIVE

Provided parts from job orders, inspection department, and inspection process, conduct inspection activities from the supervisor's arena. Follow company policy and procedures.

TOOLS AND EQUIPMENT

Inspection procedures
Parts

PERFORMANCE GUIDE

1. Submit parts for first article inspection.
2. Conduct in process inspection according to company policies.
3. Monitor discrepancy reports.
4. Follow up final product quality.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

10. TASK: Monitor discrepancy reports

PERFORMANCE OBJECTIVE

Provided the tools, process, and authority, monitor discrepancy reports on parts. Follow company policy.

TOOLS AND EQUIPMENT

Procedures
Reports

PERFORMANCE GUIDE

1. Follow reports and determine which machine and/or operator is having difficulties.
2. Determine if it is a process problem or training problem.
3. Take corrective actions, as needed.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

11. TASK: Initiate part change notices

PERFORMANCE OBJECTIVE

Provided with job order, process sheet, parts, and a change notice, initiate part change orders. Follow company policy and procedure.

TOOLS AND EQUIPMENT

Change orders

PERFORMANCE GUIDE

1. Based on evaluation of part and process, initiate engineering change notices.
2. Initiate part rejection notices.
3. Write requests for deviation.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

12. TASK: Supervise plant and personnel

PERFORMANCE OBJECTIVE

Provided with plant, machines, and personnel, perform supervisory functions as per job description and need. Follow company procedures.

TOOLS AND EQUIPMENT

Operating facility

PERFORMANCE GUIDE

1. Supervise personnel and their work.
2. Supervise machine use.
3. Inspect shop equipment and facilities.
4. Check for safe work conditions.
5. Appoint safety committee and supervise activities.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

13. TASK: Coordinate maintenance

PERFORMANCE OBJECTIVE

Provided shop, equipment, production demands, and schedule, coordinate maintenance activities. Follow prescribed procedures.

TOOLS AND EQUIPMENT

Maintenance schedules

PERFORMANCE GUIDE

1. Arrange maintenance and repair work.
2. Prepare preventative schedules.
3. Evaluate preventative schedules.
4. Prepare repair schedule.
5. Observe maintenance and repair.
6. Evaluate repair activities.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

14. TASK: Plan and coordinate training

PERFORMANCE OBJECTIVE

Provided with personnel to manage and train, plan and coordinate training for employes. Follow company policy.

TOOLS AND EQUIPMENT

None

PERFORMANCE GUIDE

1. Plan technical training for employes.
2. Implement training plan.
3. Evaluate plan.
4. Revise plan.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

15. TASK: Follow-up problem reports

PERFORMANCE OBJECTIVE

Furnished with reporting system for problems, followup reports and take action appropriate. Follow policy.

TOOLS AND EQUIPMENT

Problem report

PERFORMANCE GUIDE

1. Collect reports.
2. Study reports.
3. Follow up employe reports on equipment failure, safety violations, and work condition problems.
4. Take actions to correct problem or direct to proper source.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

16. TASK: Manage personnel policies in plant

PERFORMANCE OBJECTIVE

Provided with personnel policies, manpower needed, and employe problems, manage the personnel policies in the plant to the best of your abilities. Follow company and government policy.

TOOLS AND EQUIPMENT

Policy

PERFORMANCE GUIDE

1. Interview job applicants in a professional manner.
2. Hire workers according to regulations.
3. Dismiss workers according to policy and with just cause.
4. Layoff workers according to policy in time of need or labor excess.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

17. TASK: Contract for outside work

PERFORMANCE OBJECTIVE

Provided a full work schedule and operation not performed inside plant, contract for outside work with vendors. Follow policy.

TOOLS AND EQUIPMENT

None

PERFORMANCE GUIDE

1. Determine work to be done by outside firm.
2. Write contract for work with outside firm.
3. Coordinate outside vendors.
4. Evaluate contracted work.
5. Make recommendations about contracted work and vendors.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

18. TASK: Conduct meetings

PERFORMANCE OBJECTIVE

Provided assignment, personnel, policies and reports, conduct meetings to inform workers, and make proposals to management.

TOOLS AND EQUIPMENT

None

PERFORMANCE GUIDE

1. Organize thoughts.
2. Provide agenda.
3. Set up meeting room.
4. Take minutes.
5. Use visual aids, as needed.
6. Monitor discussion.
7. Close meeting.
8. Evaluate process and results.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

19. TASK: Make estimates

PERFORMANCE OBJECTIVE

Provided with part drawing by customer, make estimate. Must be done in timely manner.

TOOLS AND EQUIPMENT

Part drawing
Forms

PERFORMANCE GUIDE

1. Estimate materials, labor, and setup.
2. Calculate any cost overruns.
3. Price per part and per lots.
4. Prepare bid document.

DUTY BB: PERFORM SUPERVISORY FUNCTIONS

20. TASK: Supervise assembly operations

PERFORMANCE OBJECTIVE

Provided with job order for part requiring assembly operations, assign and supervise assembly to drawing specifications.

TOOLS AND EQUIPMENT

None

PERFORMANCE GUIDE

1. Make assignment to department and personnel.
2. Check progress regularly, especially at crucial times.
3. Inspect final assembly.

DUTY CC: DEMONSTRATION INDUSTRIAL SAFETY

1. TASK: Comply with safety, health, hygiene, and grooming rules

PERFORMANCE OBJECTIVE

Given a shop environment and working equipment, exhibit safety, health, hygiene, grooming rules, and operation of safety equipment according to company and/or supervisor's requirements.

TOOLS AND EQUIPMENT

Company Safety and Health Handbook
Working equipment and tools per situation

PERFORMANCE GUIDE

1. Obtain copy of company Safety and Health Handbook.
2. Read appropriate sections.
3. Exhibit appropriate behavior.

DUTY CC: DEMONSTRATION INDUSTRIAL SAFETY

2. TASK: Select and utilize tools and equipment correctly

PERFORMANCE OBJECTIVE

Given tools and equipment, select the appropriate tools and/or equipment; demonstrate proper use to meet supervisor's requirements.

PERFORMANCE GUIDE

1. Select appropriate tool/equipment for task.
2. Demonstrate correct use of selected tool/equipment.
3. Comply with manufacturer's safety requirements.

DUTY CC: DEMONSTRATION INDUSTRIAL SAFETY

3. TASK: Participate in disaster control and emergency exercises

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PERFORMANCE OBJECTIVE

Given an emergency/disaster situation, perform company control exercises to company standards.

PERFORMANCE GUIDE

1. Obtain company standards.
2. Demonstrate understanding of standards.
3. Perform to standard.

DUTY CC: DEMONSTRATION INDUSTRIAL SAFETY

4. TASK: Maintain a clean, orderly work area

PERFORMANCE OBJECTIVE

Given a workspace or area, maintain a clean, orderly workspace/area through inspections, reporting, and correcting of safety hazards related to shop equipment as determined by company supervisor.

PERFORMANCE GUIDE

1. Inspect, clean, and organize work area.
2. Report deficiencies.
3. Correct safety hazards.

DUTY CC: DEMONSTRATION INDUSTRIAL SAFETY

5. TASK: Participate in company safety program

PERFORMANCE OBJECTIVE

Given job assignment, utilize skills and apply policies as needed to complete accident reports, apply basic first aid, participate in safety committees, and safety training programs to the satisfaction of company policy.

PERFORMANCE GUIDE

1. Determine skills and policies needed.
2. Complete reports accurately.
3. Complete training, as needed.
4. Attend meetings regularly.
5. Apply training and skills, as needed.
6. Pass company safety tests in all areas.

TOOL AND EQUIPMENT LISTING

Abrasive cloths and sticks
Adjustable parallels
Air pressure gage
Alignment bar
Allen wrenches
Angle plates
Antistatic compound
Arms
Assorted threading tools
Bandsaw
Bandsaw welder
Barrels
Bearing pullers
Belt dressing
Belts and parts
Bevel protractor
Blade cutter
Blade stock
Blade welder
Blocks
Bluing
Boring bar and tool
Boring machine
Brooms
Brush
Brushes and blades
Bucket
Buffer
Bulb blower
Burnishing tools
CAD system
CNC machine and tools
Calculator
Center drills
Center gage
Centerbore
Centerhead
Centers
Chainfall
Chalk
Charcoal
Charts
Chisels
Chuck wrench
Clamps
Cleaner
Cloth
Clutch
Collets
Computer
Concrete drill
Countersink
Crane
Cup flaring wheel
Cutter
Cutting fluid
Cutting oil
Cylinder
Cylindrical grinder
Deburring tools
Depth micrometer
Diagram
Dial caliper
Dial indicator
Diamond dresser
Dies
Dividers
Dollies
Dovetail cutter
Dowel pins
Drawing furnace
Drawing tools
Drill and drillpress
Drill chuck and key
Drill grinding attachments
Drill point gage
Drilling fluid
Drilling machine
Dye penetrant materials
Edge finder
Electrode
End mill
Engineer's specs
Extractors
Face shield
Faced stock with drilled hole
Faceplate
Feeler gage
Files and records
Fittings
Fixturing
Flashlight
Floor sweep
Flow meter
Follower rest
Forms
Four jaw chuck
Gaskets
Gear blank and tooth cutter
Gear tooth vernier
Glass bead machine
Gloves
Go and no go gages
Graphic programming station

Grease
Grease gun
Grinder
Guarding
Hacksaw
Hammer
Hand reamers
Handtools
Hardened bolts
Hardness tester
Heat treat furnace
Heavy equipment
Height gage
Helicoil
Hex wrench
Hoists
Holding devices
Hole gage
Hone
Hoses
Indexing head
Inspection equipment
Jacks
Jewelers tool set
Jig bore
Job order
Lapping block and plate
Lathe
Lathe tools
Layout fluid
Levers
Lifts
Light
Lubricant
Machine lube
Magnetic base
Magnifying glass
Mandrel
Manuals and handbooks
Measuring tools
Micrometer
Milling cutters
Mirrors
NC editor
Nails
Never sezze compound
90 degree angle plates
O-rings
Oil
Operating procedures
Optical comparator
Outside micrometer
Overhead crane
Overhead lifts
Paint
Paper towels
Parting tools
Pencil
Pinch bar
Pipe
Pistons
Plastic mallet
Pliers
Plug gage
Plumbing tools
Portable grinder
Precision measuring tools
Presentation equipment
Process sheet
Profilomitor
Prussion blue
Punch
Punches
Quality control and assurance guidelines
Quench bath and medium
Quick change holder and chuck
Radius gage
Rags
Reamers
Reports
Retaining ring pliers
Robot
Rockwell tester
Rotary table
Sample parts
Sanders
Saw
Schedule board
Schematic
Scrapers
Screw pitch gage
Screwdrivers
Scribe
Seals
Sets
Shim stock
Shot peen machine
Shovels
Sine bar
Sleeves
Softhammer
Solvent
Spare parts
Special ground tools
Special group recessing tool
Special thread gage
Spotfacing tool
Spray equipment
Spring arbor

Spring steel
Squares
Steady rest
Steel ink
Steel rule
Step blocks
Straight edges
Straps
Stud bolts and nuts
Sump pump
Surface gage
Surface roughness comparator
T-slot cutter
Taper attachment
Tapping attachment
Taps
Teflon tape
Telephone
Telescope gage
Templates
Tensile test samples
Test bar
Test equipment
Thinner
Thread files
Thread measurement wires
Thread pitch gage
Thread wires
Three jaw chuck
Timing devices
Tin snips
Tongs
Tool post grinder
Tooling
Torch
Transit
Turning tools
Valves
Various indicators
Vee block
Vernier caliper
Verniers
Vertical mill
Vibratory deburring machine
Vises
Volt/ohm meter
Watch
Weights
Welder
Wheel
Whet stones
Wiggler
Wire
Wood Cribbing
Wood spacers or metal parallels
Word processors
Work holding parts
Wrenches